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In this Issue

AUGUST, 1943

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War Lesson No. 1 95
EDITORIAL FOREWORD

Glass Cellulation Produces Lightweight Insulation 98
By NORMAN G. FARQUHAR

Liquid Chlorine Systems 102
By WILLIAM H. MAGEE

Making Apple Syrup, a Glycerine and Sugar Substitute 104
EDITORIAL STAFF

Infra-Red Penetrates Many Process Industries 105
By E. H. ROBINSON

New Approach to Continuous Reactor Design-II 107
By A. BROTHMAN, A. P. WEBER and E. Z. BARISH

Corrosion of Iron by Ammonia 111
By HUGH J. McDONALD and MORRIS FELLER

Fallen Animals, A Little-Known Process Industry 112
By W. MERLE ROBINSON

Fluorescent Method Detects Leaks in Process Vessels 116
By FRANKLIN CATLIN

Alcohol for War and Postwar 119
A *CHEM. & MET.* REPORT

Salicylic Acid and Salicylate 132
A *CHEM. & MET.* PICTURED FLOWSHEET

Chem. & Met. Plant Notebook	117	From the Log of Experience	167
Process Equipment News	127	Meetings and Conventions	173
Chemical Engineering News	139	News From Abroad	186
News From Washington	141	Chem. & Met. Bookshelf	197
Interpreting Washington	145	Chemical Economics and Markets	207
New Products and Materials	151	Current Prices	213
Personalities	159	New Construction	216

An index to advertisers will be found on page 344

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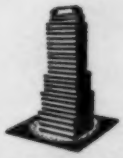

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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 AUGUST, 1943 S. D. KIRKPATRICK, Editor

OUR WAR LESSON NO. 1

WHEN the complete history of this war is written, one of its most interesting and dramatic chapters will deal with the contributions of American scientists and engineers. The little known but highly important work being done on war problems in university and industrial research laboratories will some day make an amazing record of achievement. Meanwhile, tens of thousands of men and women, interrupting their careers in science and industry, are giving unstintingly of their time and effort. What's to become of this work after the war? Are we going to close the book, as we did after World War I, and let someone else worry about the science and technology of national defense?

Some of the eminent men who are high in the councils of the Office of Scientific Research and Development believe it will be difficult or impossible to hold such an organization as theirs together once the war is won. They say that the country's scientists and technologists are willing to accept coercion and regimentation only as long as their services are immediately needed by the armed forces. After that they want to scatter to the four winds, to pick up their peaceful pursuits, to forget about their war work—except perhaps to write some books or publish some scientific papers on subjects no longer under secrecy orders.

All this is a very natural reaction to a very unnatural state of affairs. The scientist is an individual. While he may shun personal publicity, he wants and usually demands credit for his professional achievements. He is often an idealist, sensitive to criticism of his motives. He resents the idea of his work being prostituted to what some one may call an unsocial or inhumanitarian end.

It is not strange, therefore, that before the war our universities were often the meeting places for the professional pacifists. Organizations like World Peaceways boasted of the professors and college presidents in their membership. The same situation obtained in Great Britain. Admiral Blandy, U. S. Chief of Naval Ordnance, in a recent and classic address on "Research for War," tells about a British airplane manufacturer who in 1935 attempted to contribute £10,000 for an aeronautical fellowship at Cambridge and thereby roused a storm of protest because he was accused of trying to promote war research. Such controversies were not arising at that time in Germany and Japan—or in Russia, either. Only one year before Hitler came into power, a chair was set up in the University of Berlin for the study of war economics. Geopolities kept abreast of military science and added to the brutal success of German might in 1939 and 1940. We in the democracies had to learn, almost too late, that total war affects every part of our economy.

Fortunately, the Machiavellian plans of our enemies have all but failed. The eventual triumph of our cause was never more certain. Yet, in all honesty, we should ask ourselves whether or not we have learned and are still learning lessons from this war that will help us to be better prepared in the future. If our experience this time has convinced us that we made a mistake after the last war when we abandoned all war research except that in a few half-starved arsenals, then we should start now in a program of public education.

The layman, who in the end determines both our military and educational policies, must be made to realize that our destiny as a Nation depends on the use we make of science and technology. If in spite of our ideals we are to be challenged periodically by enemies who have plotted our destruction, then practical idealism calls for preparedness. It calls for a realization that we must never again neglect the things that are most important for our national defense. Research is certainly one of these. If we have learned our lesson well, we will insist on the continuation of some of the contracts with educational institutions whereby young men are trained and kept abreast of the science and technology of war.

IMPENDING CHANGES IN A.S.T.P.

ARMY demands for chemical engineers in the military service are so few that no more young men are to be assigned for training under the Army Specialist Training Program. This decision was reached during July after a resurvey of the needs for chemical engineers in uniform.

That there is a continuing demand for men of such training in the chemical process industries, however, is fully recognized in Washington as well as throughout the country. The Army is studying methods by which it might assist in meeting this industrial need. One proposal is that the Army should continue to train young men as chemical engineers through the A.S.T.P. arrangement with the understanding that such trainees, on completion of courses, would be assigned on furloughs to industrial positions. The positions would be those in industry in which Ordnance, Chemical Warfare, Air Corps and other Army units are directly interested because the research or manufacturing thus aided by young engineers would be of direct concern to the military.

Up to August 1, no specific program had been formulated which had full approval of both industrial and military executives. It is hoped that the Manufacturing Chemists' Association can serve as a liaison between the two groups in the formulation of a workable scheme. Such results would enable properly prepared and competent young trainees taken by the Army to go ahead with their chemical engineering education. Incidentally, the quality of the training would be guided by joint action of Army, industrial and educational leaders. Thus the men would be of a quality suited to the jobs to which they would be assigned. Numerous difficulties lie ahead of the completion of the program; but early in August the proponents were hopeful as to results.

FLUID FUEL INSURANCE

FLUID fuels can be made from solid minerals. This fact has long been known. But we still do not know what technology will best serve for the processing of oil shale, bituminous coal and lignite when a petroleum substitute is the objective. Something should be done about this.

A specific proposal is now being considered by the Senate Committee on Public Lands. The proposal is that a substantial sum be authorized for use of the U. S. Bureau of Mines in the investigation of methods for producing synthetic liquid fuels from coal and other solid mineral materials. Led by Secretary Ickes, an impressive group of officials has appeared before the Senate Committee urging the enactment of this bill, S. 1243.

Experienced chemical engineers will not agree with all of the alarming predictions about petroleum shortage, nor will they accept all of the super-optimistic forecasts of success for any experiments in liquefaction of coal under American conditions. But there is ample evidence to support the general idea that more fundamental studies should be made. These should encompass the best proposals for making either gaseous or liquid products from oil shale, bituminous coal, or lignite. Investment in sound research will be good insurance against fluid-fuel shortage in the years to come. One needs to be neither an alarmist nor a political propagandist to accept the broad principle of this bill provided the management of the engineering studies can be left with the competent technical staff of the Bureau.

WHICH WAY OUT?

EQUITABLE policies for the termination of war contracts at the cessation of hostilities are already demanding increased attention. Several proposals are before Congress including a standard termination clause that is being developed by the Procurement Policy Division of the W.P.B. A recent business conference held with the support of the U. S. Chamber of Commerce, has suggested (1) an overall termination procedure grouping contracts and subcontracts; (2) prompt payment of 75 percent of all claims without audit; (3) avoidance of duplication in audits; (4) review of both facts and law in disputed cases; (5) allowances for costs of amortizable facilities, postwar conversion, losses on other contracts and ordinary business expenses; (6) adoption of the principle of settlement by negotiation and (7) reasonable limitations on establishment and uses of reserves.

Many private industries suffered almost interminable delay in their contract settlements after the first World War. Let us hope we may be better prepared this time.

DANGEROUS STOCKPILE LEGISLATION

A BLOC of western senators is making an early start on plans for a postwar mineral stockpile. They recite the serious difficulties in getting minerals for war use and argue that Uncle Sam should never again risk such shortage. Their arguments are sound, but only in so far as they relate to the need for mineral reserves. The technique for corrections which they propose is an appalling distortion of sound economics and technology.

Their proposal is that domestic mining interests be subsidized for a certain period after the war in order to stimulate production of strategic and critical materials. They have in mind both the present war effort and postwar preparedness. But, clearly running through the Scrugham bill (S. 1160) is a plan to subsidize marginal and sub-marginal mining enterprises in this country. In fact, one of the stated purposes of the bill is "to avoid the widespread economic distress and failure among small or marginal mine owners . . ."

An unmined mineral resource is already a form of stockpile. The product of such a mine is often no more valuable if in some reserve storage than it would be if still in the ground as a proven resource. In many cases, with change of political policy, a reserve in a stockpile may be dissipated, whereas a resource in the ground would not be. These are well-established facts. They are facts which are ignored in the plan for

mining out these marginal ore reserves irrespective of current use and needs.

The chemical process industries are among the principal users of many strategic and critical materials, whether produced in this country or imported from abroad. They are, therefore, directly concerned with any postwar plans for stockpiles. Perhaps if their selfish needs as consumers were balanced against the equally selfish interests of the mineral producers, better legislation would result. In any event they should be consulted.

MORE PLANT CONSTRUCTION

CHEMICAL plant construction will not stop. In fact, in the strictly chemical industries it may be greater next year than last. This point is emphasized because some readers have misunderstood *Chem. & Met.'s* editorial of last month which started with the statement that "Building war factories is nearing completion."

Our comment was intended to refer to general construction and not to specialized jobs for chemical manufacturing. Many of these latter projects are still to be built. In fact some Washington officials estimate that we will spend more millions on new chemical manufacturing facilities during the next twelve months than during the last.

However much we spend, and whatever the chemicals may be that we shall plan to make, there still remains the important point we have frequently emphasized. Construction from now on should be built with a view to its postwar service to American industry. That objective cannot supersede questions of immediate war value, however, but such consideration can and should be taken into account so that both war and postwar will be served to the maximum possible extent as we expand manufacturing facilities or as we modernize them.

WASHINGTON HIGHLIGHTS

COAL STORAGE must be carefully planned. It is not enough to get plenty of coal into storage, although that is important right now. So also is proper piling and ventilation of the piles, especially of coals which tend to heat in the stockpile. Even those coals that do not heat badly enough to cause spontaneous combustion may depreciate much more than necessary during storage when incorrectly piled.

ENRICHMENT of foods by addition of vitamins and nutritive mineral ingredients is now required for bread and certain other important commodities. War Food Administration is also trying to decide how all flour used in the household shall be similarly enriched. Thus, we must eat our vitamins and minerals whether we want them or not. But it means business for those companies that make synthetic vitamins and prepare the food minerals in the special forms required.

POSTWAR LABOR will work under a 30-hour week if C.I.O. has its way. Also, it will be governed by the legislation of a strong labor Congress, according to well laid plans of labor leaders. These are matters which can well be discussed with present members of Congress when they are home this summer among their constituents.

DEFERMENT cases of critical character should be referred more often for the assistance of the National Roster. Shortages of technical manpower in industry and in research are becoming more of a threat to the war effort than a shortage of chemical manpower in the armed forces. Official Washington will be very glad to have employers request review of difficult deferment cases by the Committee on Chemists and Chemical Engineers of the National Roster of Specialized Personnel, Washington, D. C. Local boards should also be urged to use this source of impartial, competent advice.

GOVERNMENT OWNERSHIP of a great many establishments at the end of the war period is certain. About 15 billion dollars worth of such plants had been financed with public money before the end of March, 1943, and the total grows monthly. Nearly 10 percent of this total is made up of plants making "chemicals, petroleum and coal products." It is evident, therefore, that chemical executives are going to have a big job of negotiation when postwar settlement comes. It will be important to know who fixes the policy and how much continuance of government ownership or government competition with private business will then be sought. See the Washington News pages for some thoughtful comment by Jesse Jones.

CASEIN PRICES have been raised to encourage the sale of skim milk from farms. O.P.A. took this action because of the urgent need for casein in plastics, paints, insecticides, glue, paper coating and other industrial applications. Thus at least one group of lawyers and economists in this unpredictable agency confesses that the law of supply and demand must function in order to move goods from one use to another, even in war time. Would that others there were equally smart.

RUBBER problems of large importance and of considerable number remain to be solved. But it is now evident that by almost superhuman effort on the part of chemical engineers in the rubber, chemical and petroleum industries, synthetic rubber production is getting under way on a huge scale in an unbelievably short time. Washington is delighted. It feels that this is one of industry's outstanding wartime achievements. It is even talking about how soon there will be plenty of tires for everybody. This is a bit unfortunate, to be sure, because tires for every jallopy are not likely to be available for many months to come. But the "well done" which one hears so frequently in Washington of late is an honest, sincere, and well deserved tribute.

RAYON vs. COTTON is one of the star controversies of the day. The issue is: Will scientific facts or political pressure determine what kind of fabric (cord) is to be used in making heavy-duty tires? For the safety of those who use the vehicles, all technical men earnestly hope that the facts will win.

CHARCOAL prices have been increased materially under the new ceiling set by O.P.A. This will give temporary relief to the charcoal producers, but it certainly will also invite vigorous new competition. Some users are finding that certain types of non-caking bituminous coal will do almost as well as charcoal in some furnace reducing-reagent jobs. Hence charcoal producers who take advantage of the 50 percent increase in ceiling prices may later find themselves entirely without business among such customers.

Glass Cellulation Produces Lightweight Insulation

To insure a uniform product, moisture is eliminated from the specially prepared cullet in this gas-fired rotary dryer at the very start of the process. After drying, the cullet is ground in a large ball mill

NORMAN G. FARQUHAR *Assistant Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

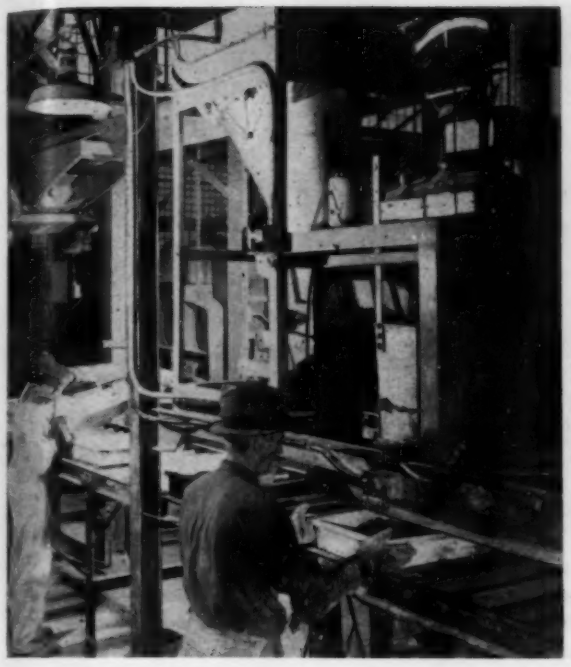
Of the many products developed during the last year or so, Foamglas, Pittsburgh-Corning's cellular glass, is one which will be widely used in the years to come. Whether for air-conditioning of buildings, for cold storage facilities or for insulation of industrial equipment, there will be numerous applications for this lightweight insulator which also provides resistance against gas, moisture, fire and vermin. Its production and properties are described here for our readers.—*Editors.*

GLASS, ALREADY WIDELY USED in the field of heat insulation, now offers a remarkable, new cellular insulation material of about the same density as commercial balsawood or cork. Produced by the Pittsburgh-Corning Corp., the new product known as Foamglas is made by a chemical reaction somewhat analagous to the raising of bread dough with yeast. Certain oxides in molten glass react with a small quantity of carbon to make carbon monoxide and dioxide gases which are trapped within the glass and form tiny sealed air chambers numbering more than 5 million in one cubic foot.

Since its structure is cellular rather than porous, Foamglas is impervious to both water and vapors, a property not available in any other known material except some of the organic cellular rubbers. The combination of inorganic glass, the vapor-tight cellular structure, light weight, high compressive strength and potentially low manufacturing costs is responsible for Pittsburgh-Corning's enthusiasm and willingness to incur heavy development costs in spite of war time difficulties and hazards.

Probably the best known application of Foamglas is its use as the buoyant element in several types of flotation apparatus for the U. S. Navy. However, it is expected that there will be many other uses for this new product in our peacetime economy. One important field which Foamglas has already invaded is that of low-temperature insulation where its permanent resistance to water is a vital factor. It seems likely that Foamglas will be used as a structural insulating element in prefabricated wall, floor and roof sections for the buildings of the future. Even under today's conditions maintenance engineers are finding it an ideal answer to the very real problem of getting an insulated roof that will retain its original resistance to heat transfer without requiring frequent replacement or repairs. In this use it is becoming customary to lay standard built-up roofing over 2 in. or more of the glass. Foamglas will support its own weight in any type of wall construction without danger of crushing or packing, which makes it ideal for building up self-supporting partitions or curtain walls of solid insulating material. It should not, however, be used for load-bearing walls.

The chemical process industries will be quick to find new applications in connection with equipment, such as stills, columns, and other heat exchange apparatus. On ovens, furnaces and other high temperature units, Foamglas can be used for hot-side temperatures up to about 1,000 deg. F., provided the service conditions do not impose sudden or violent thermal shocks. This permits its use in a large number of processes in various industries.



A batch of about 10 lb. of the finely ground cullet and carbon is measured by these automatic weigh scales, dropped into stainless steel molds and fed to the firing furnaces

After firing for approximately three hours, the blocks are "stripped" from the molds by "strippers" and immediately placed in annealing lehrs for a thirty hour heat treatment which is closely controlled by instruments

DEVELOPMENT OF THE PROCESS

For about fifteen years prior to 1941, only intermittent interest in the process for making cellulated glass had been shown by investigators in France, England and the U. S. A. However, early in 1941, a serious development project was begun by the Pittsburgh Corning Corporation at a newly constructed pilot plant in Port Allegany, Pa. Here, such rapid strides were made that in a few months construction was started on a full-scale plant alongside the existing glass block factory.

The new plant consists of a one-story building containing approximately 50,000 sq.ft. of floor space. It is of modern construction with a steel frame on reinforced concrete foundations. Floors are also concrete, walls are of brick, glass block and corrugated asbestos, partitions of tile, and roofing of tar and felt over gypsum plank in one portion and waterproofed corrugated asbestos over the furnaces. Three complete process units having a combined capacity of about 25,000 bd.ft. per day have been installed in one-half of the plant, the layout having been planned to permit installation of three additional units when expansion is required. At present all three units are running at capacity rate with their entire output going into essential uses, mainly for flotation applications for the United States Navy, and as a low-temperature insulation material.

RAW MATERIALS

The two essential raw materials used are a specially prepared form of cullet and finely divided carbon. The former is obtained from the primary melting furnace in the adjacent glass block factory and stored in bulk, while the latter is received and stored in 10 lb. paper bags. Particular care is exercised to prevent foreign matter, especially of an organic nature, from contaminating the cullet, and to this end a specially constructed storage space has been provided within the plant. Otherwise, impurities in the batch would affect the cellulating reaction and the product would be improperly formed with blow holes as in imperfect metal castings.

PREPARATION OF BATCH

To insure uniform chemical reactions in the furnace, the cullet is thoroughly dried and ground. Drying is accomplished in a counter-current rotary-type dryer, constructed of steel, and fired by natural gas. The dryer is fed by means of buggies known as "Georgia buggies" which bring the cullet from storage and charge it at a rate of approximately 60 lb. per min. Dried cullet discharged from the dryer is picked up by buckets on a belt elevator and carried to the cullet hopper, an elevated steel bin used for an intermediate storage and feeder supply.

Grinding the cullet and mixing the carbon with it are completed in one continuous operation in a large ball mill driven by a 150-hp. motor through a silent chain drive. A batch-way feeder consisting of a small steel hopper installed on scales and fed from the cullet bin discharges 150 lb. to the ball mill through a scoop feeder at intervals of five minutes. The carbon is weighed manually and fed to the mill in a ratio of less than 1 percent of the glass charge. The ball mill itself is a steel shell 8 ft. in diameter by 14 ft. long, lined with 4 to 5 in. of buhrstone. Texas flint pebbles about 2 in. in diameter are used to grind the mixture as it travels down the length of the mill in a period of about five hours. Approximately 95 percent of the final mix will pass through a 325 mesh screen, the larger particles being recycled for further grinding.

After grinding, another bucket elevator picks up the mixed batch and discharges it to a steel batch bin where it is available for the firing operation. A vibrating feeder conveys the finely pulverized mixture to automatic weigh scales which are located near the furnace entrance. Passing under the scales is a roller conveyor bringing molds which carry the charge through the furnace. The molds are made of ¼-in. stainless steel in two sections consisting of upper and lower halves and are tapered in both width and length to facilitate removing the block after firing. Each mold is also coated with a dextrin-kaolin mixture to keep the powdered glass from sticking to it

when heated. A charge of about ten pounds seems to just about cover the bottom of the mold, but produces a Foamglas block which, after trimming, measures 6 in. x 12 x 18 in.

CELLULATION

The furnace into which the charge is fed on a roller drive is about 60 ft. long and gas-fired by means of 80 separate burners. This large number of burners is necessary to insure uniformity of temperature, one of the most important process conditions. Entering the furnace at a temperature of 1,250 deg. F., the glass and carbon mixture is subjected to a controlled three-hour heating. As the molds pass slowly through the furnace on cast alloy rollers, the temperature is first increased to a maximum of about 1,550 deg. F., then lowered again to 1,150 deg. F. near the point of discharge. A special device automatically controlled by photoelectric cells comes into play here and subjects the mold to a temperature of 1,350 deg. F. for three minutes before ringing a bell to notify the operator that the mold is ready for removal from the furnace. This final boost in temperature causes the stainless steel to expand slightly and separate from the Foamglas which has now blown up to fill the mold. At this point the Foamglas Block closely resembles a black mass of foam, and its density has changed from about 50 lb. per cu.ft. to 10 lb. per cu.ft.

The molds are moved out of the furnace on rollers to the operators, or "strippers," who are ready with asbestos gloves to "strip the molds" and

Physical Properties of PC Foamglas

Specific Gravity	0.17 (10 to 11 lb. per Cu. Ft.)
K (Conductivity at 70°F.)	0.45 B.t.u./Hr./Sq.ft./°F./In.
K (Conductivity at 300°F.)	0.70 B.t.u./Hr./Sq.ft./°F./In.
Coefficient of Expansion (°F.)	.0000046
Specific Heat	16 to .19 B.t.u. per lb. per °F.
Crushing Strength	150 lb. per sq. in.
Modulus of Rupture	90 lb. per sq. in.
Impact Strength (Center Drop-increment method, on 8" x 16" x 5" thick specimens supported on a 12" span)	66 ft.—lb.
Absorption (24 Hr. Immersion in Water)	0.4% by Volume—2% by Weight (All at surfaces)
Air Infiltration or Permeability	0
Capillarity	0
Volume Change with Moisture	0

Standard Sizes and Packing

Glass size	Pieces per carton	Approximate weight per carton
12 x 18 x 2	12	38.0 lb.
12 x 18 x 3	8	37.5 lb.
12 x 18 x 4½	6	41.5 lb.
12 x 18 x 6	4	37.0 lb.

A view of the new Foamglas plant at Port Allegany, Penna. Typical of glass plant construction is the huge monitor which provides ventilation for the hotter parts in the building. Also in evidence are the walls of glass blocks made in the adjacent plant

place the blocks in a lehr for annealing. Doors and rollers on furnaces and lehrs are controlled by push buttons conveniently located near the operators.

The stripped molds are placed on a roller conveyor and carried back to the loading scales via a spray booth. In this booth each mold is thoroughly cleaned and sprayed with the dextrin-kaolin mixture described above. To protect the operator of the spray apparatus from furnace radiation an insulating wall of Foamglas block has been installed between the furnace and spray booth.

ANNEALING THE BLOCKS

Annealing Foamglas blocks is accomplished in gas-fired recirculating lehrs 110 ft. long and of a highly special design. On a steel wire belt 10 ft. wide, twelve blocks up on end are carried abreast through a temperature gradient from 1,050 deg. F. to 125 deg. F. The time required for annealing varies, of course, with the thickness of the slabs and the rate of cooling, with a maximum cycle, under present operating conditions, of about 30 hours. One outstanding point in the design of the lehrs is the 26-in. free tunnel height which is unusually large for the glass industry and gives greatly increased capacity. Generally, the difficulty of maintaining uniform temperature at all points in the entire cross-section of the lehr necessitates keeping the tunnel height to a considerably smaller dimension.

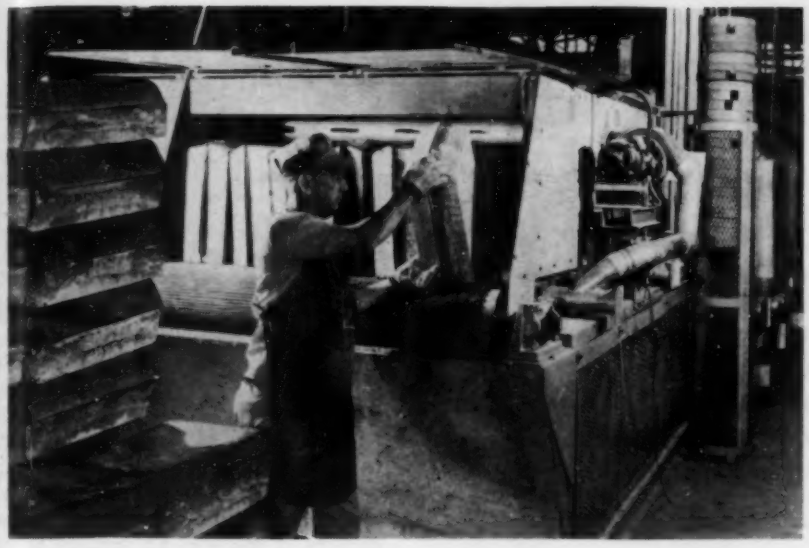
FINISHING AND PACKOUT

Annealed rough blocks of Foamglas from the lehrs are manually loaded onto skid platforms or traveling conveyors for delivery to the final trimming machines. Here each block is individually cut and shaped, first in a face trimmer and then an edge trimmer. These trimmers cut the blocks by means of rotating wheels, the face trimmer being equipped with two 36-in. steel-centered carborundum wheels. The base size of the blocks is 6 in. x 12 in. x 18 in., but they are easily sliced on a bandsaw to produce lesser thicknesses such as 4½ in., 3 in. or 2 in. Standard cardboard cartons are used to pack the final product for shipment after an inspection of each block has been made.

Tailings from the trimming and slicing operations are carried away on a conveyor belt to a stirrup crusher in a pit below floor level and then discharged into a hopper. When the hopper is filled, a monorail and trolley hoist remove it to a dump outside the building. As yet these tailings have not been put back into the process.

VENTILATION

Typical of glass plant construction is the huge monitor ventilator above those parts of the plant where most of the heat is concentrated in processing. In addition, a modern dust collector system keeps the entire plant effectively clean and free from dust in spite of the fact that several very dusty operations are performed. A network of ducts connects the spray booth, automatic weigh machine and trimming machines with a large bag-type dust collector. The dust from this collector is disposed of in the same manner as the tailings from the trimming machines.



Taken from the lehrs after annealing, the rough blocks are loaded onto skid platforms or travelling conveyors for delivery to the final trimming machines. Lehrs are the recirculating type specially designed to give a 26-in. free tunnel height thus providing greater capacity

CONTROL

Centrally located between the rows of furnaces and lehrs is an elevated glass-inclosed control room insulated with Foamglas. Here are installed various recorder controllers for the gas burners on each furnace and lehr. Numerous additional temperatures are read on an indicating pyrometer by means of a selector switch and plots are made of the temperature of the Foamglas blocks as they move through the lehrs. These permanent records advise each shift foreman of what has happened on the previous shift, and also provide information which is invaluable in quality control work. By locating this room centrally above the operating floor, a good view of the entire plant is obtained, and a considerable material saving was made in the initial installation of lead wire for the thermocouples. The company's research and factory control laboratories are housed in a separate building nearby. A comprehensive program of further research on cellular glass is underway, directed toward finding new ways to make this unique product, and the solution of the problems connected with the proper application of the material to the many commercial uses already encountered.

PROPERTIES

Saws or any other ordinary cutting tool are perfectly satisfactory for shaping or fitting Foamglas blocks for installation, and a simple asphalt-cement mixture applied between blocks provides a bond that is secure and durable. The inorganic nature of cellulated glass precludes the possibility of attack by vermin and also provides resistance to acid atmospheres and other corrosive materials. Foamglas is not only non-combustible, but also acts as a fire retardant, an important factor when it is to be used in combination with combustible material. Its heat conductivity, which at 70 deg. F. is 0.45 B.t.u./hr./sq.ft./deg. F./in., and at 300 deg. F., 0.70, will not change in spite of the presence of any amount of moistue. Obviously, therefore, in cases where water or dampness act to nullify the insulating value of other materials, Foamglas will prove a boon to industry.

The specific heat of Foamglas ranges from .16 to .19 B.t.u. per lb. per deg. F., while its coefficient of expansion (deg. F.) is .0000046. On the opposite page is a table of the physical properties of PC Foamglas giving complete details which should be of interest to engineers who design and install insulation of any kind. The sizes currently available are also listed.

Left—Foamglas block in an edge trimmer. Rough blocks as they come from the lehrs have uneven faces and tapered edges which must be squared off in face trimmers and edge trimmers. The final product as shown after trimming is a perfect block 6 in. x 12 in. x 18 in.

Below—Temperature control and regulation is centered in a glass-enclosed room centrally located in the plant. Here a battery of recorder controllers operate the furnaces and lehrs and foremen chart various temperatures in the process

Liquid Chlorine Systems

WILLIAM H. MAGEE, *Application Engineer, Worthington Pump and Machinery Corporation*

Chem. & Met. INTERPRETATION

A radical departure from the conventional chlorine-condensing system is here presented involving the substitution of a vertical shell-and-tube condenser for the horizontal type. Important operating improvements offered include continuous purging of non-condensable gases, better heat transfer efficiency and easier cleaning.—*Editors.*

FROM OBSERVATIONS in the field of chlorine liquefaction, there seems to be opportunity for considerable improvement in the design of chlorine-condensing systems. The horizontal shell-and-tube condenser, where the chlorine gas passes through the tubes and the refrigerant through the shell, is the generally accepted style of apparatus. Usually these condensers consist of two or more horizontal units arranged in a vertical bank and connected so that both gas and refrigerant form series circuits. Depending upon the size of the condensers, the end boxes are fitted with partition plates so that the chlorine gas passes through the tubes of each unit in a series of two, three, or four groups, usually referred to as two, three, or four passes. With this arrangement, it is supposed by some that the rate of heat transfer is improved since the gas makes several passes through the tubes before the liquid and noncondensable gases are discharged into the liquid receiver.

Present general practice of arranging condensers to give the gas several passes through the tubes is, no doubt, the result of substituting the shell-and-tube condenser for the double-pipe type which was used in the early days of chlorine-liquefaction-plant construction, and is still used in plants of small capacity. These double-pipe condensers consist of a series of horizontal pipes arranged in a vertical bank and so connected that the gas to be condensed enters the top inside pipe and the liquid leaves the bottom inside pipe. The refrigerant is passed through the annular space between the inside and outside pipe, entering at the bottom and leaving at the top of the bank. The practice of passing the gas through the inside pipe was adopted to facilitate cleaning the cooling surface which becomes coated with sludge from suspended matter carried into the condenser with the chlorine-gas mixture. This arrangement, of course, requires that the noncondensable gas be swept through the condenser in a downward path and purged from the top of the liquid receiver located below the condenser.

Purging from the receiver alone becomes increasingly difficult as liquefaction progresses, because the proportion of noncondensable gas above the liquid increases with chlorine liquefaction. As this gas mixture is reduced in chlorine content, it becomes lighter and rises in the condenser to dilute the rich gas entering the top of the condenser. Purging from the top of the condenser is not possible, so that condenser performance becomes worse as time goes on until the chlorine liquid yield falls off due to a high proportion of noncondensable gas at the cooling surface.

The reasons frequently given for the low capacity of shell-and-tube condensers per unit of cooling surface are:

1. Scaling of the cooling surface due to sludge from the cell gas. The horizontal tubes are about the worst that could be selected to avoid the accumulation of scale or sludge.

2. Low velocity of the gas through the tubes of the condenser. For consideration of this problem, a simple calculation indicates that with a raw gas containing 90 percent chlorine entering the condenser under 35 lb. gage pressure at 120 deg. F. and condensing at 10 deg. F., the highest mean velocity that might be expected would be 35 percent of the initial velocity, and the minimum velocity would be obtained at 23 percent of the gas travel in the tubes. This minimum velocity is about 28 percent of the initial velocity. From this we can see that 77 percent of the cooling surface is in contact with gas flowing at the lowest velocity. To obtain a minimum velocity really effective, the initial velocity would be prohibitively high, or the condenser would have to be designed in some freak style with tubes having graduated tube diameters.

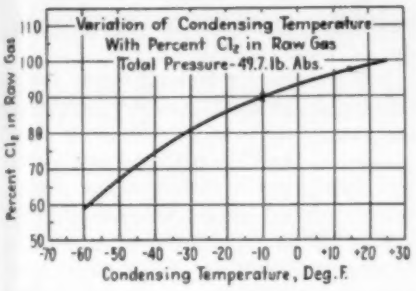
3. Insufficient temperature difference between gas and refrigerant. There is no reason to suppose that chlorine gas condensers require any greater temperature spread than other condensers if the cooling surface is proportioned to the heat load, using the same classification of factors in the calculations.

4. Insufficient refrigerating capacity to handle the heat load from the condenser. The properties of chlorine and the usual noncondensable gases (mostly air) are sufficiently well known to allow for heat-balance calculations of reasonable accuracy.

The above comments seem to leave us with the necessity of finding a reason that cannot be so easily refuted for the poor performance of chlorine condensers. Considering the raw gas mixture at 35 lb. per sq. in. gage pressure condensing chlorine at 10 deg. F., we find that the residue gas mixture contains about 72 percent chlorine and 28 percent inert gases. For this raw mixture the weight of chlorine liquid is about 160 times that of the residue gas mixture. As our aim is to purge residue gas from the condensing system by a continuous process in order to maintain a constant rate of chlorine liquefaction, we arrive at the conclusion that the noncondensable gases must be ejected in the proportion of 72 percent chlorine to 28 percent inert gases.

To accomplish this, the condenser arrangement must be such that the gas to be ejected will leave the condensing system by the easiest path and not mix with the incoming raw gas which has a much higher chlorine content. A vertical condenser radically different in design from the usual present-day practice, seems to be the best arrangement to accomplish the desired results.

The condenser must be a vertical shell arranged to permit the chlorine-gas mixture to pass through the tubes in order to facilitate cleaning of the cooling surface. The top and bottom heads must be easily removable for cleaning. Raw gas must enter at the bottom and pass up through the tubes,



This curve showing operating temperatures for various concentrations of chlorine which might be found in raw gas fed to the condenser is based on the recovery of 90 percent of the chlorine. Temperatures required for other percentage recoveries may be easily calculated from vapor pressure data

and the liquid formed on the cold inner wall of the tubes must run down the wall of the tubes without being picked up by the gas stream. The liquid-collecting receiver must be located directly below the condenser, and the liquid outlet pipe from the condenser must be sealed in the liquid to prevent warm incoming gas from contacting the surface of the liquid in the receiver.

Since part of the suspended matter in the gas will fall down through the tubes, it will be necessary to provide some means for conducting it into the receiver, where a sump must be provided for collection of the sludge so that it will not be carried out of the receiver with the chlorine liquid. To compensate for heat leakage through the wall of the receiver, and to completely separate the residue gas from the gas film at the surface of the liquid, the receiver should be fitted with some refrigerating surface to cool the chlorine liquid to a temperature lower than the condensing temperature.

A vent pipe should be connected from the top of the receiver to the exit pipe from the top of the condenser so that all uncondensed gas will leave the system through a common purge valve. A magnetic valve may be made to operate automatically, piloted by a pressure switch which can be adjusted to open the purge valve at a pressure close to the predetermined condensing pressure. The chlorine content of the purge gas will then be very close to the desired percentage as long as the pressure and temperature are maintained constant. If the condensing system is made two-stage for close stripping of the chlorine from the gas mixture, both primary and secondary condensers would be of the same design, and the purging would be effected from the top of the secondary condenser.

The outstanding advantages of the vertical tubular condenser over the horizontal condenser, either double-pipe or tubular, can be summed up as follows:

1. Actually separates chlorine condensate from noncondensable gases in a free path for both gas and liquid.
2. Makes use of all surface in circumference of tube for condensing.
3. Prevents dilution of rich incoming gas with noncondensable mixture above the surface of the liquid.
4. Minimizes fouling of cooling surface by allowing excess sludge not attracted to the cold surface to drop down through tubes.
5. Obtains better overall heat transfer, thus reducing initial investment in cooling plant.
6. Maintains closer terminal temperature difference between chlorine condensing temperature and refrigerant, thus requiring smaller refrigerating apparatus for the same predetermined set of operating conditions.

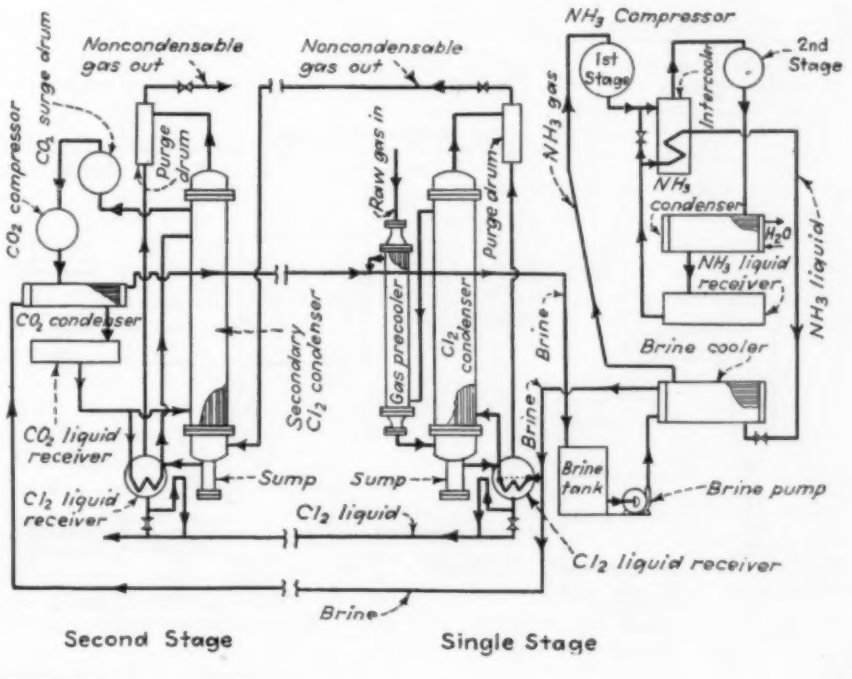
In a commercial chlorine liquid plant, where the chlorine content of the purge gas should be kept low, a two-stage system will be justified. If the purge gas can be used in some process outside of the actual production of chlorine liquid, a single-stage plant may be satisfactory, and would reduce the initial cost of equipment as well as the power cost required for driving refrigerating machinery.

The choice of a refrigerating system is, as a rule, not hard to make. If there is plenty of cold water, say at 60 deg. F., available in the hottest weather, a simple CO_2 refrigerating system may be used for the single-stage condensing system, or a two-stage CO_2 system for the two-stage condensing system. If the cooling-water temperature is high, the single-stage condensing plant may use a two-stage ammonia compressor with calcium-chloride brine as a secondary refrigerant circulated through the condenser. For the two-stage condensing system when the cooling water temperature is high, a good combination would be an ammonia refrigerating system cooling calcium-chloride brine for the first condenser, and a CO_2 direct refrigerating system for cooling the secondary condenser.

It will be found that the above selections pretty well cover the requirements of medium and large capacity chlorine condensing plants. The small low-yield plants may require special treatment in design and selection of equipment where initial investment is the greater factor and power cost is a lesser consideration.

It is, of course, possible to consider the use of other refrigerants such as the Freon group with either reciprocating or centrifugal compressors. In fact, any refrigerant that will meet the temperature requirements may be used if the application is made in a manner that will avoid the natural hazards of chlorine and refrigerant mixture.

This schematic diagram shows a single-stage stripper complete with ammonia-brine cooling system. Also shown is a second-stage required for close stripping when the chlorine content of the purge gas must be kept low. If cooling water were available at low temperature all year round, it would be possible to substitute a CO_2 refrigerating system for either the single or double stage setup



Making Apple Syrup Glycerine and Sugar Substitute

EDITORIAL STAFF

Chem. & Met. INTERPRETATION

Apple syrup is one of the group of wartime developments that has proved to be superior in some applications to the material for which it was substituted. It combines both hygroscopicity and sweetening in a single material. It is of particular interest to such industries as pharmaceutical, tobacco, cosmetics, cork, paper, cellophane, leather and textiles.—*Editors.*

APPLE SYRUP is a combined sweetening and hygroscopic agent that is gaining attention as a wartime substitute for sugar and glycerine. In the postwar period it will probably continue in favor in the tobacco and other industries which heretofore have had to use two materials to impart both sweetening and hygroscopicity. A process for its production has been developed by the Eastern Regional Research Laboratory of the U. S. Department of Agriculture at Philadelphia. During the past apple season approximately 3,000,000 lb. was produced by five companies. It is expected that 15,000,000 to 20,000,000 lb. will be made by 18 to 20 organizations in the 1943-44 season. During much of the last season the OPA ceiling prices on apple syrup was 16c. a lb., or $1.84 a gal. This ceiling was subsequently removed to permit further production of the material so badly needed by the tobacco industry, but since then the price has not materially increased.

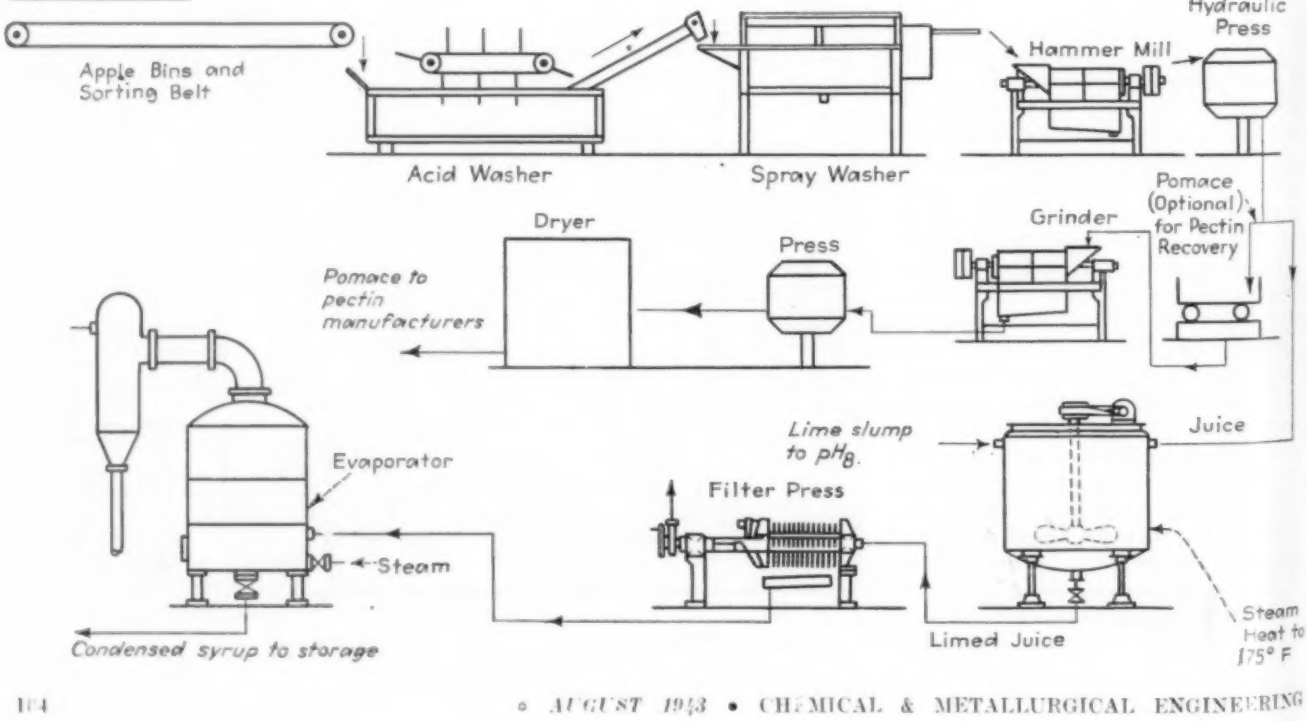
This new syrup is 85 percent as hygroscopic as glycerine. It is 30 percent sweeter than cane sugar syrup of equal solids content. The clear amber colored solution has no aroma or distinctive apple or other characteristic odor. Sugars are in about the same proportion as they are in apple juice: 49 percent levulose, 14 percent dextrose and 13 percent sucrose. It is non-jellying, and free flowing at 68 deg. F. Specific gravity = 1.37 — 1.39, Baumé = 40.0-41.5, brix = 73.7-76.7, pH = 5.0-5.5, and refractometer = 72-75 deg. equivalent to refractive index of 1.4700-1.4774.

The process for making apple syrup developed by the Eastern Regional laboratory starts with vinegar or cider apples, as well as peelings and cores. This raw material includes fruit that is sound but off-grade because of size, shape, or surface defects. Immature or overripe fruit has a low sugar content and, therefore, is not used. The fruit is first washed free of spray used in the orchard. The clean apples are passed through a hammer mill and the juicy pulp is collected in frames and wrapped by a coarse cloth into cakes known as "cheeses." A number of cheeses are conveyed to a hydraulic press where the juice and pulp are separated by a pressure of 2,000 lb. per sq. in. The pulp, or pomace as it is called, is given a second pressing if it is to be subsequently dried for pectin recovery.

The juice, at a temperature of at least 78 deg. F. which is necessary to prevent precipitation of a lime-sucrose compound, is treated with a lime slurry (1 lb. of hydrated lime per 1 gal. of water) to obtain a pH of 8.0 to 8.5). Vigorous agitation during addition of the lime prevents localized action of lime on inert sugars. The temperature of the solution is then raised to 175 deg. F. in order to accelerate action of the lime on the pectin, causing a precipitation of calcium pectinate. The sweet apple juice and precipitate are separated in a plate and frame filter press. Diatomaceous earth is used

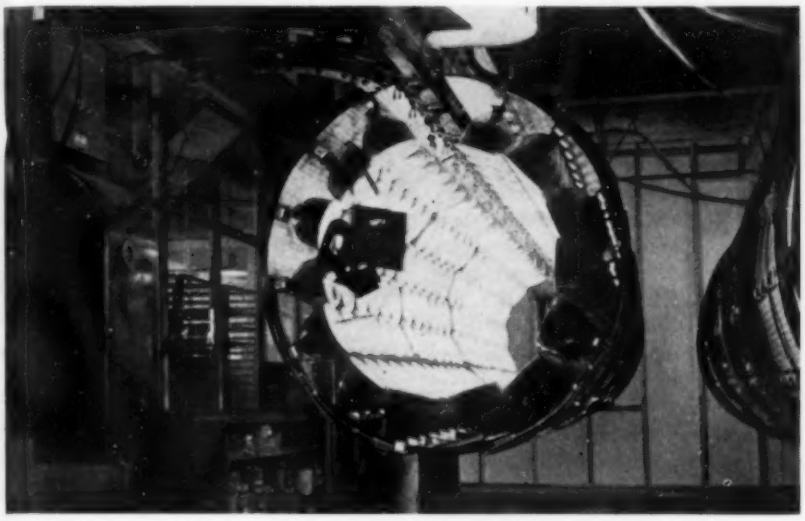
(*Please turn to page* 106)

Flowsheet for the production of bland apple syrup and pomace, a raw material for pectin manufacture



Infra-Red Penetrates Many Process Industries

E. H. ROBINSON *Engineering Department, General Electric Co., Nela Park, Cleveland, Ohio*



Infra-red oven that can be expanded to form a square or a triangle

Chem. & Met. INTERPRETATION

In the February, 1940, issue of *Chem & Met* paint baking with near infra-red was discussed by H. J. Bennett and Howard Haynes. Since that time engineers have discovered that radiant energy from infra-red lamps can substantially speed a variety of drying, baking and dehydrating operations in many process industries.—*Editors.*

THE PERIOD OF PROBATION for infra-red drying and heating is over. When the first information on newly-developed infra-red units became available, about four years ago, plant engineers were quick to foresee their possibilities. A year later a number of successful applications had been made and result-information had begun to accumulate. The first use-data on drying with lamps resulted from a series of successful tests made by engineers of the Ford Motor Co., experiments involving thousands of therapeutic lamps housed in automobile headlight reflectors. As further experiments progressed, the first oven designers, the engineers from lamp manufacturing companies and the utility power men who worked out other early installations discovered that radiant energy from special infra-red lamps could substantially speed a variety of drying, baking and dehydrating processes.

Equipment and installation costs were proving to be lower, warm-up periods were eliminated. Even in these first experimental applications there was no stand-by loss; the installation could be turned on or off as the heat was needed.

Because infra-red equipment was compact and needed little space, it soon found new and wider applications. Accessible and adjustable, it could be applied to an almost unlimited variety of products and processes. It was safe and economical, and men could work with it in greater comfort.

By the middle of 1942, war uses had greatly increased the scope of effective applications. Infra-red was then applied to the drying and processing of shell cases and land mines. It was used to dry finishes on tanks and jeeps, on the protective shields for airplane landing lamps, on practice bombs and large caliber guns.

Although the drying of paints and finishes was its commonest early application, by mid-year 1942, scores of other effective applications were being made. Infra-red was heating asbestos for bending, pre-heating, and de-humidifying plastic compounds, helping to join thermal plastics. In the paper and paper products industry, heat-lamps were helping to accelerate sizing, drying lacquer and other finishes and aiding in the processing of paper fabricated products. The manufacturers and users of infra-red dried latex coatings found that curing temperatures were well within the range of this new heat source. In textile mills, it was de-humidifying wool, helping to sanforize cotton, and process rayon.

While the number and variety of its war production applications has been rapidly broadened, the present trend is unmistakably toward simplification. At the General Electric Co. in 1940, engineers started with 11 types of infra-red heating and drying lamps. The first WPB order reduced this number to 9. Later, our own laboratories, by continuous infra-red research, cut the number of G-E infra-red lamps first to 7 and later to 6. As this article is written, the 250 watt R40 lamp with its own inside reflecting surface of vaporized illuminum is finding more war production applications than all of the other sizes combined.

The discovery of new applications and effective standaridzation of the heat source itself would seem to justify more general consideration of infra-red for drying, baking, and dehydrating. Preheating is an important adjunct to the molding of plastics. It is a vital part of the established technic of the handling of high-impact materials and in the molding of such compounds as the transparent methacrylates, where the moisture in the compound may result in white specks that will mar surface finishes. Preheating and de-humidifying with infra-red lamps can reduce or eliminate excess moisture in plastic powders and improve the yield by removing the cause for surface de-

fects. Obviously, the reduction of rejects can materially increase production per hour.

At room temperatures many of the thermal plastics are difficult to shear or punch without cracking. Pre-heating of plastic sheets and shapes before they are sheared or punched has proved to be a very effective method for the control of this type of spoilage.

Infra-red has been successfully applied to plastic parts and units which must be joined by the use of special cement. Pre-heating the separate parts without carrying the heating process throughout the entire body of the plastic has proven to be successful. Heat can now be applied directly to the parts to be fitted and heating the entire body of the shape itself is no longer necessary.

Thin ribbons of plastic powders can be passed over a series of vibrator plates so that all of the powdered particles are subjected to the penetrating heat rays from an infra-red panel. Each powdered particle as it is carried on the conveyor plates is turned by vibration, thoroughly heated and dehydrated and at the same time raised to the desired temperature for processing. This simple process produces a continuous flow of free-running plastic powders. By controlling the speed of passage through the conveyor the materials can be delivered to the molders with exactly the right moisture content.

Where plastics are used for sealing, there has been a considerable degree of success in the use of infra-red. Insulation material can be poured over the top of storage batteries, for example, and the heating and drying lamp can control the temperature so that an even flow of the plastics will seal all possible leaks in the top of the battery case. This single application has materially accelerated the manufacture of storage batteries, and at the same time, considerably reduced drying and storage costs.

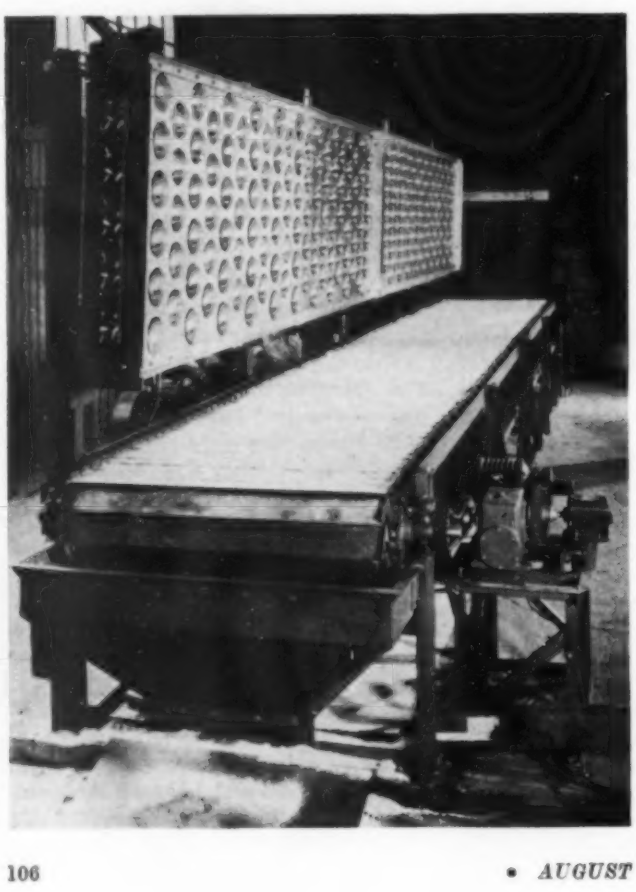
The actual dehydration of wet paper stock is a tough job for any drying agent. Infra-red, however, has found successful application in de-humidifying moist paper stock, has been used for drying lacquer coatings and has greatly accelerated sizing operations. Paper processors are using the new heat source successfully to dry glues in the fabrication of boxes and cartons.

The use of infra-red drying lamps in the rubber industry is rapidly becoming increasingly important. Banks of drying lamps are accelerating the drying of coatings such as latex, liquid rubber, and a number of solutions which are carefully guarded war secrets. Within the range of the infra-red drying process are temperatures which set rubber-cement for many aircraft and other army and navy devices. Even the simple matter of drying cement prior to the application of rubber soles on service shoes is a practical application for the use of the R40 lamp. Proper temperatures are readily obtained, easily controlled, and can be applied in many ways.

Infra-red is being used to accelerate the over-all speed of many types of machines in the textile industry. The process has been successfully used on various types of sanforizing machines and has been used for drying of the lightweight cloth as well as the heavier materials such as wool blankets, rugs, and carpets. It has been applied satisfactorily to dehydration in the process of combing wool. It dries single threads. Banks of lamps have been so arranged that threads are passed through the heat rays to dry both cotton and rayon thread. There are many instances where the threads themselves are impregnated with binder and filler and dried by infra-red to speed the weaving process. In the printing of design on cloth, infra-red has been very effective and accelerates the speed with which these materials can be bolted and stored.

The development of infra-red, in all of its phases, would seem to justify serious consideration in most war plants. Wherever it has been applied to drying, de-humidifying and dehydrating, one plant engineer has given another "The go-ahead for infra-red."

Conveyor-dryer, opened to display twin lamp-banks, dries plastic binder between two layers of plywood



APPLE SYRUP

(*Continued from page* 104)

in the limed juice and as a precoat in the press, approximately 4 lb. per 100 gal. of juice are required.

The filtrate is acidified with a 1:5 solution of sulphuric acid with constant agitation to obtain a pH of 5.0 to 5.5. The acidulation lightens the color, eliminates the alkaline taste and avoids the effect of an alkaline reaction on levulose. The acidified juice is concentrated in a stainless steel, glass-lined or copper evaporator under a vacuum of 25 to 29 in. to a syrup of 75 percent soluble solids (75 deg. brix).

A ton of fruit yields 160 gal. of juice or 211 lb. of syrup, assuming 12.5 percent solids in the juice and a 10 percent juice loss in processing. Likewise a bushel of apples (48 lb.) yields 5 lb. of syrup, and a gallon of 12.5 deg. brix juice yields 1.32 lb. of syrup.

The pomace left after pressing out the juice from the apples can be disposed of, as is, to supplement cattle feed; or else ground, repressed, and dried by kilns or rotary dryers to 5-6 percent moisture for sale to pectin manufacturers.

Additional information relative to industrial applications of the product may be obtained from the Chemical Engineering and Development Division, Eastern Regional Research Laboratory, Chestnut Hill, Philadelphia, Pa., who will supply necessary data to manufacturers wishing to go into production of the material.

New Approach to Continuous Reactor Design—II

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Chem. & Met. INTERPRETATION

This is the second of three articles dealing with a new theoretical approach to the design of continuous processing equipment for carrying out liquid-phase reactions and other combining and mixing operations. Methods developed by the authors enable the engineer to design readily for a close approximation of the result which will actually be achieved by equipment so designed, and to do so with a greater degree of certainty than by earlier methods. The first article, appearing in our July number, derived the basic expression showing the retention time of each proportion making up the effluent from a continuous liquid-phase system of one or more vessels in series. The present article couples this expression with the combining-velocity characteristics for various kinds of combining phenomena. The last article, to appear in an early issue, will show how the new methods are utilized in an actual design problem, demonstrating the effect of variations in equipment capacity and arrangement.—*Editors.*

CONTINUOUS PROCESSING has numerous important advantages for the chemical and process industries, as was explained in the first article of this series (*Chem. & Met.*, July 1943, pp. 111–114 incl.). However, the design of continuous reactors and other combining equipment has been hindered in the past by the lack of a rational mathematical theory capable of giving performance predictions which would agree closely with the actual capabilities of equipment so designed. The authors have developed such an approach, the fundamental basis of which was outlined in the first article.

It was there stated that the object would be to calculate the mean level of completion of a particular combining phenomenon in the effluent from a continuous mixer, dissolver, or reactor, consisting of one or more vessels in series, according to the equation:

$$S = P_1 f(t_1) + P_2 f(t_2) + \dots P_n f(t_n) \quad (1)$$

where S is the mean completion of the combining phenomenon; P_1, P_2, etc., are the proportions of the discharge respectively corresponding to the retention times of t_1, t_2, etc.; and $f(t_1)$, $f(t_2)$, etc., are the extents of completion of the combining phenomenon at hand, in terms of functions of t_1, t_2, etc. By an approach through the algebra of combinations it was shown that the proportion of material leaving a continuous system of m vessels after a retention time of n passes in the system was equal to $\phi(m, n)$, or

$$\phi(m, n) = \binom{n-1}{m-1} p^m q^{n-m} \quad (9)$$

for all values of m from 1 to ∞ and all values of n from m to ∞; and that, furthermore,

$$\sum_{n=m}^{\infty} \binom{n-1}{m-1} p^m q^{n-m} = 1 \quad (10)$$

since the sum of all proportions comprising the discharge must equal 1. In these equations $q = (1 - p)$ and $p = R/Q$, where R is the rate of feed to the system (or rate of discharge), in gallons per minute, and Q is the circulating capacity of each individual mixer or reactor, also in gallons per minute. Finally it was noted that

$$t_m = V/Q \quad (11)$$

where t_m is the time required for a single pass from inlet to outlet in a reaction vessel or mixer having a total holding capacity of V gal. and having a general structure such as that shown in Fig. 1 of the first article in this series.

The existence of Equations (9) and (10) makes it possible to calculate the length of time that any portion of the effluent has remained in a continuous combining system, when the throughput, number of vessels, capacity and circulating characteristics are known. Hence, it is only necessary to couple the information so obtained with the combining-velocity characteristics of a particular process to be able to predict the degree of completion of the process that will be obtained under the assumed conditions.

First, let us consider a first-order reaction. The integrated form of a first-order-reaction velocity equation is

$$t = \frac{2.303}{k_1} \log_{10} \frac{a}{a - x} \quad (12)$$

where k_1 is the reaction-velocity constant under a given condition of temperature, pressure, and *agitation*; a is the concentration of the starting reactant in mols per unit of volume in the reaction system; x is the depletion in concentration of the starting reactant in mols per unit of volume after a time interval of t; and t is the time of stay in the system after the desired reaction conditions of temperature, pressure, and agitation have been established. We may write t in terms of nt_m (Equation 11), and hence

$$n t_m = \frac{2.303}{k_1} \log_{10} \frac{a}{a - x} \quad (12a)$$

It is obvious that the completion of the reaction could be measured in terms of $[a/(a - x)]$, and hence we may write

$$\lambda_1 n = \log_e \frac{a}{a - x} \quad (13)$$

where

$$\lambda_1 = k_1 t_m \quad (14)$$

and, finally,

$$\frac{a}{a - x} = e^{\lambda_1 n} \quad (15)$$

Similarly, $[b(a - x)/a(b - x)]$, as the measure of completion of a second-order reaction,* may be written

$$\frac{b(a - x)}{a(b - x)} = e^{\lambda_2 n} \quad (16)$$

where

$$\lambda_2 = t_m k_2 (a - b) \quad (17)$$

* This is the measure of completion for a bimolecular reaction when the two reactants are not present in stoichiometric balance.

Table IV—Approximate Horsepower Requirements for Mixers

Tank Charge, Gallons	Medium Agitation			Rapid Agitation		
	Thin	Medium	Viscous	Thin	Medium	Viscous
1 - 2	1/100	1/100	1/30	1/100	1/30	1/20
2 - 5	1/100	1/30	1/8	1/30	1/20	1/8
5 - 10	1/30	1/30	1/8	1/20	1/8	1/4
10 - 25	1/30	1/8	1/4	1/8	1/4	1/3
25 - 50	1/8	1/4	1/3	1/4	1/3	1/2
50 - 100	1/4	1/3	1/2	1/3	1/2	3/4
100 - 200	1/3	1/2	3/4	1/2	3/4	1
200 - 400	1/2	3/4	1	3/4	1	1½
400 - 600	3/4	1	1½	1	1½	2
600 - 1,000	1	1½	2	1½	2	3
1,000 - 1,500	1½	2	3	2	3	5
1,500 - 2,000	2	3	5	3	5	7½
2,000 - 3,000	3	5	7½	5	7½	10
3,000 - 5,000	5	7½	10	7½	10	15

Also,

$$\left[\left(\frac{a}{a-x}\right)^{\frac{1}{(a-b)(c-a)}}\left(\frac{b}{b-x}\right)^{\frac{1}{(a-b)(b-c)}}\left(\frac{c}{c-x}\right)^{\frac{1}{(b-c)(c-a)}}\right]$$

as a measure of completion of a third-order reaction,† may be written

$$\left[\left(\frac{a}{a-x}\right)^{\frac{1}{(a-b)(c-a)}}\left(\frac{b}{b-x}\right)^{\frac{1}{(a-b)(b-c)}}\left(\frac{c}{c-x}\right)^{\frac{1}{(b-c)(c-a)}}\right] = e^{\lambda_3 n} \quad (18)$$

where

$$\lambda_3 = t_m k_3 \quad (19)$$

Finally, $\left(\frac{C_s}{C_s - C_t}\right)$ as a measure of completion of a solids-dissolving or gas-dissolving operation may be written

$$\frac{C_s}{C_s - C_t} = e^{\lambda_4 n} \quad (20)$$

where

$$\lambda_4 = t_m A k_4 \quad (21)$$

In these equations the terms not already defined include: k_3 and k_4, the reaction-velocity constants respectively for second- and third-order reactions under the given conditions of temperature, pressure, and agitation; k_4, the solution-velocity constant under the given conditions of temperature, pressure, and agitation; a, b and c, the concentrations of materials (a) (b) and (c) at the start of the reaction, in mols per unit volume; x, the depletion in concentration of any reactant in time t in mols per unit volume; A, the area of contact between gas and liquid, or solid and liquid phases in physical dissolving systems under the given conditions of temperature, pressure, and agitation; C_s, the concentration at the saturation limit of the solute in the solvent in mols per unit volume; and C_t, the concentration of solute dissolved under given conditions of temperature, pressure, and agitation at end of time interval t.

From the above, it will be observed that when combining phenomena of the types already treated are handled continuously, the $f(t)$ of Equation (1) will take the generalized form of

$$f(t) = e^{\lambda n} \quad (22)$$

Thus for a system of m vessels (where m may equal a single unit or any number of vessels in series), Equation (1) may now be written, in view of Equation (22),

$$S = \binom{m-1}{m-1} p^m q^{m-m} (e)^{\lambda m} + \binom{m}{m-1} p^m q^{m+1-m} (e)^{\lambda(m+1)} + \binom{m+1}{m-1} p^m q^{m+2-m} (e)^{\lambda(m+2)} + \ldots \quad (23)$$

where $n = m$ for the first term, $n = m + 1$ for the second term, $n = m + 2$ for the third term, etc.; where S is the mean completion of the combining phenomenon in question, as expressed in terms of the appropriate measure indicated in Equations (15), (16), (18), and (20); and λ is given its appropriate values according to Equations (14), (17), (19), and (21). In view of Equation (10), we may express Equation (23) as

$$S = \sum_{n=m}^{\infty} \binom{n-1}{m-1} p^m q^{n-m} e^{\lambda n} \quad (24)$$

By an extension of the mathematics leading to Equation (9), with special application to Equation (24), Brothman derived the following explicit expression for S:

$$S = \left(\frac{pe^{\lambda}}{1 - qe^{\lambda}}\right)^m \quad (25)$$

where the values of p, q, and λ are determined in accordance with our previous remarks. A qualification must be placed on the use of Equation (25). If we examine Equation (24) which contributes to the development of (25), it will be noted that S must have a finite value. This limitation arises from the fact that the laws of chemical equilibria restrict the completion of combining phenomena to a finite level—in other words, no matter how complete a combining phenomenon may seem to be, there exists some (at least infinitesimal) residue of uncombined material. If we test Equation (24) for the conditions under which it will be convergent by means of the ratio method for convergency, it will be found that where

$$\mu_n = \binom{n-1}{m-1} p^m q^{n-m} e^{\lambda n} \quad (26)$$

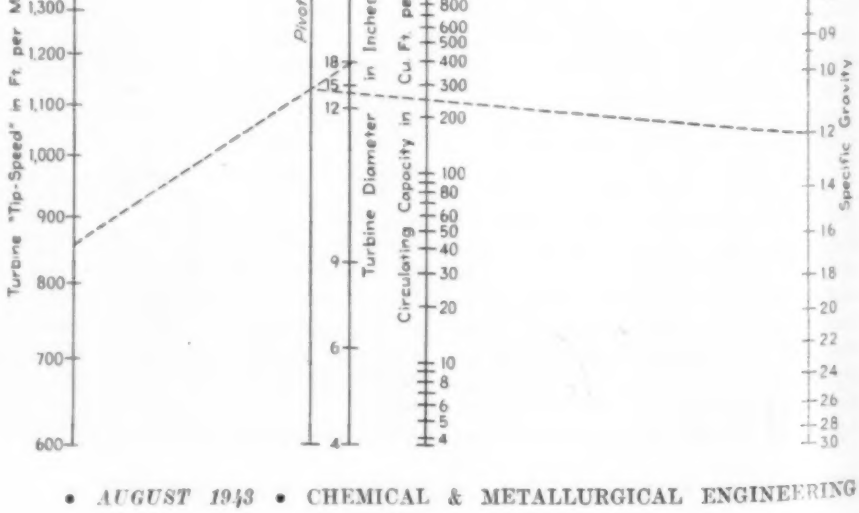
μ_{n+1} must equal $\binom{n}{m-1} p^m q^{n-m+1} e^{\lambda(n+1)}$ (27)

and

$$\lim_{n \to \infty} \frac{\mu_{n+1}}{\mu_n} = qe^{\lambda} \quad (28)$$

Where qe^{λ} is less than 1, Equation (24) will yield a finite value for S. Equation (25) itself shows that qe^{λ} can never equal 1 and yield a finite value for S. Hence the limitation on Equation (25) is that qe^{λ} must be less than 1.

Fig. 4—Nomograph for theoretical circulating capacity of turbine type mixers



† This is the measure of completion for a trimolecular reaction where no two of three reactants are in stoichiometric balance with one another.

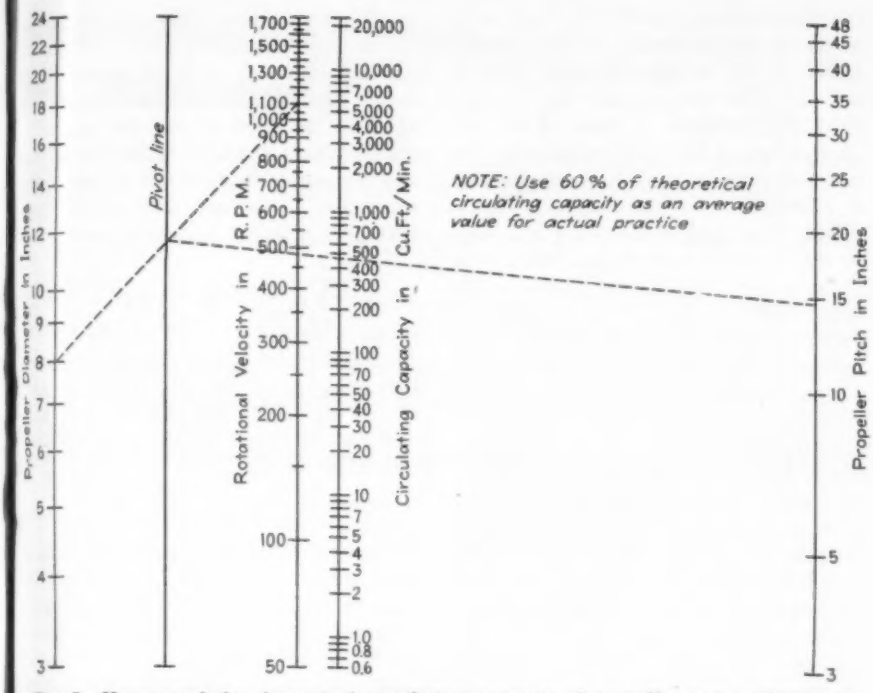

Propeller Diameter in Inches
Pivot line
Rotational Velocity in R.P.M.
Circulating Capacity in Cu.Ft./Min.
NOTE: Use 60% of theoretical circulating capacity as an average value for actual practice
Propeller Pitch in Inches

Fig. 5—Nomograph for theoretical circulating capacity of propellor type agitators at 100 percent slip

No treatment of the subject with a claim to utility could end with Equation (25) and the above-described limitation thereon. Indeed, it would be necessary at least to touch on the following questions pertaining to Equation (25): (1) How can the effect of "homogenizing" mixing be considered? (2) How would reactions and physical combining phenomena involving heterogeneous systems be handled? (3) How would reactions whose completion vs. time curves deviate from their theoretical order be handled? (4) How would series reactions be handled? (5) How can the value of Q, which enters in forming the value of p, be computed? (6) Within what limits does t_m usually run?

The effect of "homogenizing" mixing in determining the efficiency of continuous combiners expresses itself by its influence in determining the velocity characteristic or characteristics of a particular combining phenomenon. In fact, three conditions may determine these characteristics, that is, temperature, pressure, and agitation. If the conditions of temperature and pressure are kept constant, the effect of agitation will be found to vary inversely with the extent of diffusivity of the combining materials with one another and/or with the dispersion medium. For any given condition of vessel design, any given tank charge, and a given intensity of work-input, any one of three main types of agitation conditions may exist. The three possible categories into which the agitation condition may fall include: (1) A condition of non-uniformly diffused turbulence; (2) A condition of uniformly diffused minimum turbulence; and (3) A condition of uniformly diffused above-minimum turbulence (as referred to condition 2).

Condition (2) may be compared to that minimum level of linear velocity which, according to the concept of Reynolds' Number, is adequate to establish a condition of turbulent flow for a given viscosity, density and duct diameter. Conditions (1) and (3) are respectively below and above this point of transition to turbulence. The relation between reaction-velocity constant and condition of turbulence in a combining unit is analogous to the relation between film coefficient and linear velocity in heat-exchange equipment. For heat-exchange equipment a critical level of turbulence exists beyond which an increase in turbulence will be accompanied by only a small increase in film coefficient. Likewise, for a mixing system a critical level of turbulence exists beyond which an increase in turbulence will be accompanied by only a small increase in reaction-velocity constant.

Thus, the most economical balance that can be achieved between film coefficient and work-input to overcome friction drop in a heat exchanger is analogous to the most economical balance that can be achieved between reaction-velocity constant and work-input in the form of agitation in a combining system. Likewise, under normal circumstances the fluid velocity for optimum operating conditions in a heat exchanger is analogous to the level of turbulence demanded for optimum operating conditions in a combining system.

Table IV is offered as a means of estimating the intensities of work-input which will establish, for containers of indicated volumes, conditions of agitation corresponding to Conditions (2) and (3) above.

HETEROGENEOUS SYSTEMS

The method of handling heterogenous reaction and physical combining systems may most often be considered to be a special case of handling the problems of continuous processing presented by reactions which deviate from known reaction orders (as will be treated below). This is true because the completion velocities of heterogeneous systems involve consideration of the area of contact between the combining phases. However, this contact area is not usually susceptible of quantitative evaluation. Hence, as for the case of combining phenomena which deviate from the known reaction orders, empirical relationships between completion levels and time are therefore the usual form such data takes.

The job of handling reactions which deviate from their theoretical reaction orders falls into two separate categories: (1) That of handling reactions which, despite their apparent theoretical classification, obey the laws of another order. An example is the case of theoretical second-order reactions which obey the law of a first-order reaction, and are hence pseudo unimolecular reactions; and (2) The job of handling reactions which do not conform to *any* known reaction order.

The handling of Category (1) reduces to gaging the completion of such phenomena by the methods applying to the reaction order which they *do* follow in fact. The task of computing systems which belong to Category (2) reduces to obtaining an empirical equation for the completion vs. time curve demonstrated by the combining system under certain processing conditions of temperature, pressure, agitation, and formulation. Such equations should be set in the form

$$t = \phi(C) \qquad (29)$$

when C is the completion characteristic for the given system. Solution of the problem then requires algebraic manipulation in order to obtain the implicit expression:

$$S = \sum \binom{n-1}{m-1} p^m q^{n-m} e^{\lambda n}$$

which results in Equation (25). For example, assuming that the empirically determined equation took the integrated form of the reaction velocity equation for the cases where two identical molecules, or two different molecules in

stoichiometric balance with one another, are reacted, then

$$k_2 t = \frac{x}{a\,(a - x)} \qquad (30)$$

where k_2 is the reaction-velocity constant under a given condition of agitation, temperature, and pressure; a is the starting concentration of both reactants in mols per unit volume; and x is the depletion in concentration of both reactants at the end of a time interval t. As above, t may be written equal to nt_m and hence

$$k_2 n t_m = \frac{x}{a\,(a - x)} \qquad (31)$$

Therefore, where $e^{\frac{x}{a(a-x)}}$ is used as a measure of completion of such a reaction, it will be found that

$$e^{\frac{x}{a(a-x)}} = e^{\lambda n} \qquad (32)$$

where

$$\lambda = k_2 t_m \qquad (33)$$

Hence, where the mean value of $e^{\frac{x}{a(a-x)}}$ in the effluent from a continuous set-up is desired

$$\left[e^{\frac{x}{a(a-x)}}\right]_{\text{mean}} = S = \left[\frac{pe^{\lambda}}{1 - qe^{\lambda}}\right]^m \qquad (34)$$

The problem of series reactions or series physical combining phenomena may be taken to include: (1) Those combining phenomena which demonstrate different completion velocity constants at various periods during the processing operation; and (2) Those combining phenomena in which simultaneous phenomena occur during the processing operation, or in which the product of one reaction is a reactant in a simultaneous reaction.

Those phenomena which fall into (1) must be considered by dealing with each time phase (i.e., each phase of the operation to which a distinct and consistent value for the completion constant may be attached) as a separate problem involving a continuous set-up for that particular time phase. Thus the total system would be a summation of equipment to accomplish each time phase. Combining phenomena involving several simultaneous individual phenomena must be considered as reactions following no known order, since in such cases only empirical completion vs. time curves and equations can be drawn.

The values of Q for turbines and for propellers may be obtained by the use of the nomographs, Figs. 4 and 5, respectively. For general design purposes, it should be noted that the values of t_m for most usually encountered sizes of equipment run from slightly above 1 sec. in 1-gal.-holding-capacity vessels to 1.5 min. in 2,500-gal.-holding-capacity units.

In general, it should be observed that the mathematical conclusions set forth above are not restricted in their applicability to the devices shown in Figs. 1 and 2 of the first article. Let us consider, for instance, a vessel of the design shown in Fig. 6 in which a single mixer engages a liquid mass uniformly. It is notable that the design in Fig. 6 differs from that in Figs. 1 and 2 only in that a draft tube is not employed. If a system comprising units of the type shown in Fig. 6 were computed as if a draft tube were present theoretically, what might we expect of the so-computed results? It follows that since the role of the draft tube in restricting the possible retention times in the system to integral multiples of the theoretical turnover time is eliminated in Fig. 6, some deviation would exist between actual and computed results. It will be found, however, that the more uniformly the mixer engages the liquid mass in instances where draft tubes are not used, the smaller is the deviation of the computed results from the results actually achieved.

Again, let us consider a "compartmentalized" continuous combiner of the design shown in Fig. 7. Here, it will be seen that two design limitations contained in Figs. 1 and 2 are not present. First, the mixing units do not work in conjunction with either a common draft tube or individual draft tubes. In so far as the use of individual draft tubes is concerned, the remarks made above are pertinent. In so far as each unit is "compartmentalized" away from the other mixers, and since the mixers do not function in connection with a common draft tube, each of the compartments may properly be considered as an individual continuous unit and the composite unit a series of three continuous combiners. The second difference between Fig. 1 and each compartment of Fig. 7 is that the point of exit for each compartment is not located in the immediate vicinity of the point of feed. In fact, the minimum possible time of sojourn in terms of V/Q, where V/Q equals t_m, would equal approximately $\frac{1}{2}$ t_m since the point of exit for the effluent from each chamber is directly opposite the point of entry. It is apparent then that Equation (24) would then take on the form

$$S = \sum_{n=m}^{\infty} \binom{n-1}{m-} p^m q^{n-m} e^{(n-\frac{1}{2})\lambda} \qquad (35)$$

It may then be shown that the completion achieved in the effluent for a particular operation carried on in a unit as shown in Fig. 7 would modify Equation (25) to

$$S = e^{(m-\frac{1}{2})\lambda}\left(\frac{p}{1 - qe^{\lambda}}\right)^m \qquad (36)$$

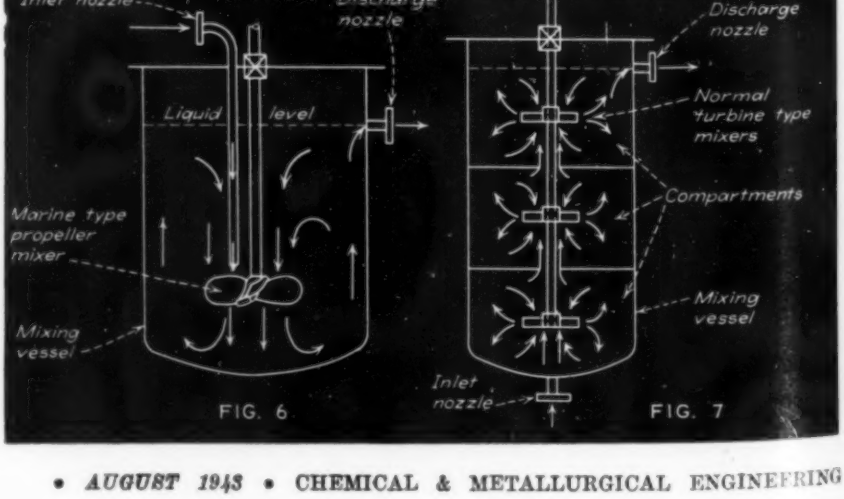
where in the indicated case m has a value of 3.

In summary on this point, we may conclude that the general approach set forth above will apply to all cases of continuous combiner design which follow in even the most general way the basic mode of operation described for Fig. 1. Specifically, any continuous mixer design employing an agitator unit which tends to approach a full and theoretically uniform turn-over of a tank mass may be computed on the basis of the theory given here, subject to the qualifications set forth above. It should be noted that all formulas other than (35) and (36), as set forth above and used in the next and concluding article, apply specifically to cases where a full analogy to the idealized diagram of Fig. 2 of the first article obtains.

Correction—In the first article (p. 114, July 1943), transcription errors occurred in the 10th and 16th lines of column (1). *Three* combinations are possible for four passes in three vessels, and *six* combinations for five passes.—*Editor.*

Fig. 6—Continuous mixer without a draft tube

Fig. 7—"Compartmentalized" continuous mixer



Corrosion of Iron By Ammonia

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Chem. & Met. INTERPRETATION

It has been determined that one percent is the critical point in the corrosion of iron by aqua ammonia. Solutions of that concentration or greater will not corrode the metal. There is increasing susceptibility to attack as the concentration falls below that strength.—Editors.

AQUA AMMONIA solutions of concentration greater than 1 percent (one part 15 NNH$_4$OH per 100 parts of water) completely prevent the corrosion of iron in the form of steel wool. Investigation also shows that in aqua ammonia solutions ranging downward in concentration from 1 percent there is increasing susceptibility to corrosion. This tendency, however, is still relatively small at 0.1 percent concentration. There is evidence of protective film formation, since steel wool which was exposed first to more concentrated NH$_4$OH solutions, then to very dilute solutions from which the NH$_3$ was allowed to escape, showed no tendency to rust. This is in contrast to the slight, but definite, tendency to rust of the steel wool in the regular very dilute solutions. The extensive rusting in the case of an altered 50 percent NH$_4$OH solution may be explained by assuming that slight "wounds" in the oxide film were caused by rinsing. Since not even a small amount of NH$_4$OH was added which would have "healed" the wounds, the infection was able to spread until the whole body was affected by the solution.

These conclusions were derived from an investigation that was undertaken to verify results of corrosion studies of earlier investigators, and also to determine, if possible, the concentration of ammonia above which there is no rusting, and below which rust does form.

Procedure: In this experiment the iron used was clean steel wool of the regular commercial variety. The ammonia solutions were made from concentrated C.P. quality, ammonium hydroxide (15N or 28 percent NH$_3$) and distilled water. The concentrated ammonium hydroxide is called 100 percent solution; one part concentrated ammonium hydroxide and one part water is a 50 percent solution, etc.

Since NH$_4$OH in aqueous solution is a weak electrolyte, the approximate concentration of hydrogen ion present in the several solutions used in this study may be calculated using the Arrhenius equation for the ionization of ammonium hydroxide, and the known value of the ionization constant. The pH value of the solutions may then be computed.

The procedure used was as follows: 100 ml. of solution was made up in a 250 ml. erlenmeyer flask. A small wad of steel wool was introduced into the flask where it lay approximately 75 percent submerged and 25 percent exposed to the "air + NH$_3$ mixture" above the solution surface. The flask was then stoppered and the solution swirled so as to wet the steel wool completely. The flasks were then allowed to stand at room temperature for a period of from two to four weeks.

The results are summarized below:

Distilled water: The appearance of the rust clinging to the steel wool and on the bottom of the flask was that of Fe(OH)$_3$. The rust deposit was continuous over large areas of steel wool both in and out of the water. By this is meant that the steel wool fibers had an unbroken coating of rust along their entire length.

100, 50, 25, 12½ percent NH$_4$OH solution: There was no apparent rusting at any time. The appearance of the steel wool surface was clean and did not show any change.

1 percent NH$_4$OH solution: After two days there was slight filament rusting in the wool above the solution. There was no evidence of rust formation in the submerged part. Standing for a period of several weeks did not alter the general appearance.

0.5 percent NH$_4$OH solution: After two days there was no noticeable deposit on the bottom of the flask. In the submerged portion of the steel wool there were several nodules or clots of rust. These were all close to the water line. Clot rusting is characterized by rust accumulating in one spot where a number of filaments cross. The clots were about ⅛ in.—¼ in. in diameter and were a brighter red than the filament rust or the deposit on the flask bottom. They had a dehydrated appearance, and after reaching a maximum size of approximately ⅛ in., they did not grow any more nor did they spread. In the wool above the solution there was slight filament rusting.

0.1 percent NH$_4$OH solution: The rusting in the wool above the solution was more extensive than in the solution. It was of the filament type while the latter was the nodule type. There was no apparent excess of rusting at the water line. When the system had reached a stable state at the end of about two weeks, most of the submerged steel wool was relatively clear.

Three of the more concentrated solutions mentioned above (50, 25, 12½ percent) were changed in the following ways:

Altered 12.5 percent solution: The original 12.5 percent NH$_4$OH was poured out and the flask and wool were rinsed twice with distilled water. Then 100 ml. of distilled water were added plus 1 ml. of NH$_4$OH; this made an approximate 1 percent solution. There was an immediately incipient Fe(OH)$_3$ formation throughout the solution and a very slight precipitate settled to the bottom. There was no other change over a period of more than two weeks. The wool above and in the solution remained free of rust.

After this period of time, the stopper was removed and the flask allowed to stand uncovered until there was no noticeable odor of NH$_3$. It then stood for another two weeks with no rusting taking place.

Altered 25 percent solution: This was treated exactly like the 12.5 percent solution except that it was converted to a 0.5 percent solution. Similar results were obtained.

Altered 50 percent solution: This was treated just like the other two solutions except that distilled water replaced the 50 percent NH$_4$OH. There was immediate incipient Fe(OH)$_3$ formation in the body of the liquid. After one day, isolated rust clots of small area appeared in the steel wool. These were few in number. With the passing of each day the deposit on the bottom of the flask increased, being apparently due to the few rust areas throughout the wool. The rust of these areas was a brighter red than that of the "blank" (original distilled water flask), but was quite cloudy and the rust areas seemed to have gone into transition from nodule to filament rusting. The heaviest rust areas were concentrated at the water line. With the passing of time the appearance of the flask became more and more like that of the blank, the exception being that there was a large percentage of greenish-black color mixed in with the red to give a much darker appearance than that of the blank.

Fallen Animals

A Little-Known Process Industry

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Chem. & Met. INTERPRETATION

Here is an extremely successful process industry that is probably little known to most chemical engineers. Yet its processes are based on unit operations and many of its plants are modern, well equipped and designed, showing the influence of chemical engineers. Almost every product is on the critical list of strategic materials. Furthermore, it is almost the sole available source of horse grease and certain other materials.—*Editors.*

MOST RENDERIES are housed in modern sanitary buildings, and are so conducted that frequently they are mistaken for country creameries or almost anything other than what they actually are. From such uninviting raw materials as the cadavers of animals having died from disease or accident, products are recovered which are all classed as essential to the nation. Every product of the fallen animal industry is on a critical shortage list, and all these are truly recovered from complete destruction or saved from becoming a menace to the health of both animals and man.

In this industry there is no typical plant, in the layout of equipment there are almost as many variations as there are plants. However, the plants are almost always built on a basic two-floor operating plan. Specially designed trucks collect and deliver the carcasses to the second floor skinning room. This is accomplished either by inclined truck drive or by power hoists. Skinning rooms are often equipped with winches to assist skinners in removal of hides, and occasionally with air-needles for hide loosening. In the more modern plants, overhead trolley systems are installed for ease in handling carcasses awaiting skinning.

After the hides have been removed, the cadavers are dissected to the extent necessary for further processing according to the rendering system in use. In plants using old style wet tanks, unit converters, or some dry-cooking systems, it is only necessary to have pieces small enough to pass through the charging doors of the tanks. This means, in the case of the larger animals, the removal of the legs, breaking the rib sheets from the spine, then usually breaking the pelvis into smaller sections. The amount of dissection indicated is also usually done in plants using "hogs" for further comminution of the raw material for rendering systems requiring "hogging."

In many plants where such practices are allowed, gut hashers and washers are found on the skinning floor, as thorough removal of gut contents insures against chlorophyll staining of the grease. The disposal of gut washer drainage water is a difficult problem. In many states, the advantages to be gained through gut washing must be sacrificed because of stream pollution danger.

Oftentimes, in plants using one of the systems in which stick is produced, there is a pan dryer in the skinning room for drying paunch manure with a little stick for use as garden fertilizer. In dry rendering and extraction plants the manure is usually destroyed either by burning or spreading in safe areas where the sunlight may kill the dangerous organisms present.

The four common systems of rendering will be discussed in order of their development.

1. *The Old Style Wet Tank and Cloth Press System*—In a plant using this type, which is the oldest of the pressure-cooking methods of rendering, the animals, dissected into quarters or smaller, are cooked in closed cone-bottom vertical steel tanks, steam passing directly into the material being cooked. These tanks vary in size from a capacity of one ton or less to big fellows holding as much as eight tons. The tanks have grease draw-off cocks on the sides, the bottoms are usually closed with drop doors, although occasionally large gate valves are used. Process-steam inlets are provided in the necks immediately above the bottom outlets. Tank water draw-off cocks are also near the bottoms, about halfway up the cones of the tanks. In the top heads are the charging doors, also the safety valve and purge line connections.

The receivers for the slush dumped from the tanks vary in design from simple concrete vats to large rectangular steel plate pan-like tanks, with quick-opening gate valves for discharge of slush to buggies for press loading.

Presses used in these older plants are mostly of the cloth and rack type, although there are a few newer types found in the older plants. In the cloth and rack press, the pack for pressing is made up of alternate layers or cheeses of slush, folded in heavy cloth, and basket-woven steel or wood strip racks. The pressure applied is seldom above 300 lb. per sq. in. of cheese surface.

Dryers used with this system are either the vertical shaft pan type or horizontal cylindrical machines, and are operated at atmospheric pressure or under slight vacuum. The steam in the jackets is usually kept at about 80 lb. pressure.

The tank water evaporators in these plants are nearly always of the horizontal tube type, with cast-iron bodies and iron or copper heating tubes. Single-effect evaporation is the rule, as most of these older plants use steam engines for power, and have an abundance of exhaust steam.

The cadavers are usually cooked under a pressure of 40 lb., the pressure and length of time varying according to such factors as variety of animals, extent of decomposition already present, size of tank, and season of the year. While cooking, the purge line is kept sufficiently open to insure that all gases evolved by the material are vented from the tank. After cooking has been completed, the tank is allowed to cool over night, or if necessitated by need for another cook, the

Typical Iowa rendery of large capacity is the plant of Cole Rendering Co., at Waterloo

Ultra-modern skinning room showing overhead conveyor system. Such systems are often used in many of the larger modern plants for ease in handling carcasses which are awaiting skinning and dissection

pressure may be relieved by opening the purge line wide, allowing the pressure to drop to atmospheric in an hour or less.

The contents of a tank are always allowed to settle before an attempt is made to withdraw the grease. The grease is drawn off through cocks on the side; often hot tank water is pumped in through the steam jets to assist in floating out pockets of grease in the middle of a tank.

Upon removal of the grease, the tank water is drained off, the bottom gate is opened to drop the slush of cooked meat and bones to the slush box, where more grease may be skimmed off, then any tank water which has not drained from the slush in the tank is allowed to drain to the sump. The material left in the slush box may contain at this point as much as 20 percent grease, if the stock being processed was straight hogs or very fat cattle.

The drained slush is pressed to remove more water and grease, then the drying of the cheeses is finished in the steam heated dryer, usually with the addition of stick to bring the protein content up from about 40 to 60 percent or higher. After being dried to two to four percent water, the tankage is ground in swing hammer or cage mills, cooled and sacked in hundredweights.

The processing of tank water, which consists of liquids from the cadavers plus steam condensed from the cooking jets, with much soluble material from the green tankage, is done at the same time that the other material is in process. The evaporators are usually operated through the entire working day, making use of the exhaust steam from engines driving plant machinery. The stick is usually concentrated to about the consistency of heavy molasses. Some few plants further process stick by drying it into "concentrated tankage," shiny black flakes analyzing as high as the equivalent of 110 percent protein because of their high nitrogen content. This drying is done on atmospheric rotating drum dryers, known as flaking rolls.

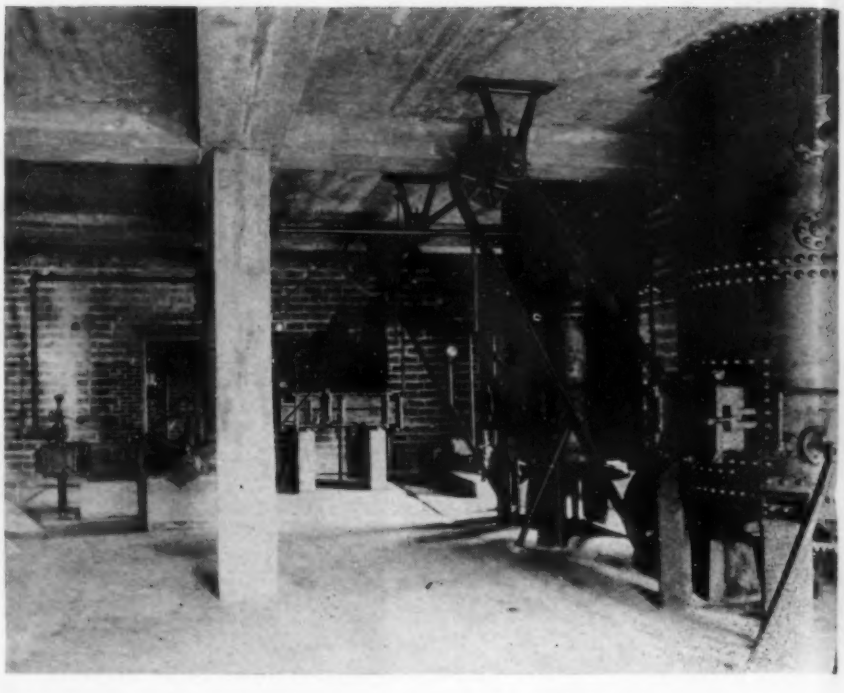
Greases are usually clarified by simple settling, generally in heated receivers, then conveyed to storage to await tank car shipment. Regardless of the system of rendering used, very few plants attempt any treatment of greases to improve quality, and seldom is there segregation so as to produce greases other than those of mixed origin.

2. *The Unit Conveyor System*—Plants operating this system cook cadavers in vertical tanks resembling vertical shaft pan dryers with inverted agitator drive, the side walls being extended to make the depth of the cookers about twice their diameter.

Each cooker has four or more cooking jets around the bottom, and the steam jacket extends up one-third the tank's height. Grease and tank water drains are provided as in wet tanks. The top parts are the same, except for the addition of a vacuum connection for removal of vapors during drying. Unit converter plants use evaporators, but no presses, and frequently no hammer mills.

This is essentially a wet rendering process, with the pressing operation omitted. The cooking, settling, grease removal and tank water drainage are all done just as they are in the case of wet tanks, but the tankage is dried while still within the tank in which processing started. Tank water is recovered by evaporation as in the older wet tank system.

The unit converter system has two marked advantages over the older wet tank system which brings it into great favor with authorities in many restricted areas, (1) The disagreeable pressing operation is eliminated, and (2) The material being processed is sealed in a single piece of equipment from start to finish. Due to the omission of pressing, greater skill in both loading and cooking is needed to produce low grease content tankage, but the advantages mentioned still make this a very popular system for fallen animal work. Furthermore, dry cooking may be easily done in these machines, and they are ideally suited for extraction operation, should this method be adopted by a plant already equipped with unit converters.



These two Morrison converters have a capacity of 5,000 lb. of animal carcasses each, and are about four and a half feet inside diameter. They were in the Montezuma, Iowa, plant of Kightlinger Rendering Co.

3. *The Dry-Rendering System*—Plants using this system cook in vertical or horizontal machines, somewhat similar in design to the dryers used in the wet system. There are no evaporators, but the most highly developed presses are used, such as the extreme-pressure curb types and expellers generally used in soybean and other vegetable oil plants. All plants doing dry rendering have hammer or cage mills for grinding the press cakes, and some have crushers or hogs for the preliminary grinding of the carcasses.

In this system, the animals, either quartered or hogged to small pieces, according to the method of operation being followed, are cooked in their own steam with release of the vapors during cooking until the material is nearly anhydrous. The technic of cooking varies to a greater extent than in any other system; internal pressures vary from a slight vacuum to about 50 lb. either throughout cooking or with varying pressures at different stages of cooking. Jacket pressures vary from near atmospheric in some exhaust steam heated machines up to 80 or 100 lb. for some of the higher pressure methods of operation.

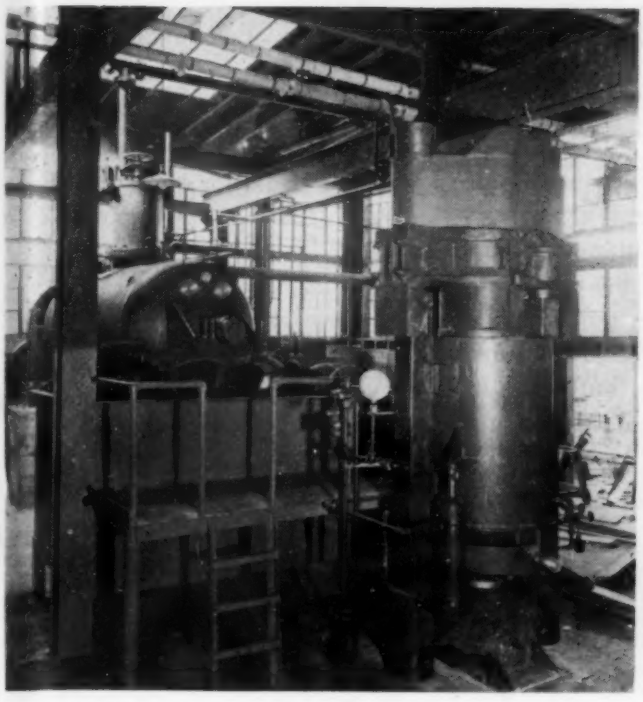
When cooking is complete, the contents of the cooker consist of grease-saturated water-free cracklings, which are dumped into a perforated bottom receiver, where much free grease drains off, and the cracklings become "tempered" and are ready for pressing. The presses, either of the curb type or expellers, reduce the grease content of the cracklings sufficiently so that the recovery of gerase with this system is higher than with any other so far discussed. Presses of the curb type are loaded either by hand or by mechanical loading devices. Expellers are mechanically fed. After pressing, the cakes are ground in either hammer or cage mills, and the cracklings are sacked in hundredweights.

Dry rendering offers many advantages, most of which are due to evaporation being limited to the water of the tissues being processed. There is no steam introduced into the charge in dry cookers, except under special conditions in some plants, and then only for aid in speeding up the initial heating of the material. With skillful operation, this system will process more material per unit of equipment and dollar invested than any other method of rendering. Nearly one-half of the plants in the fallen animal field use some type of dry cooking, either as their principal process, or for cooking hogs, these animals being very hard to handle in large proportions with other stock in the other systems of rendering, because of their high grease content.

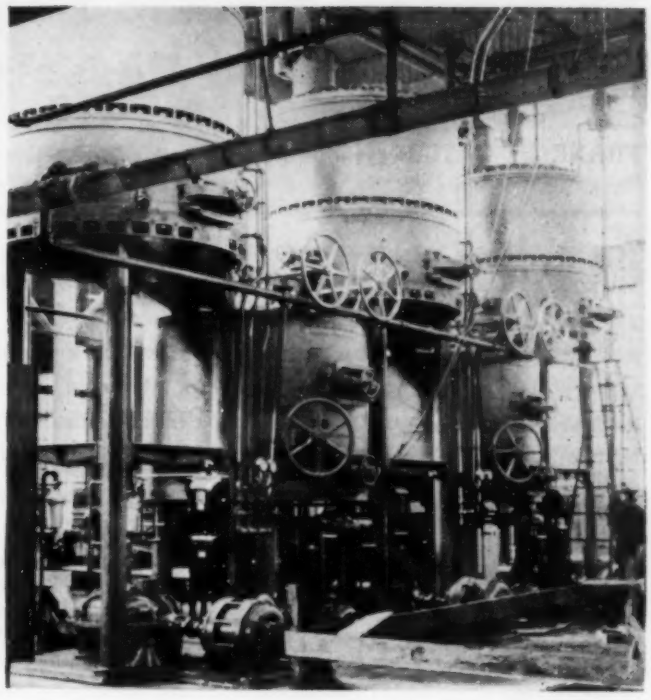
4. *Solvent Extraction System*—This system, while really a modification of the dry cooking system, is treated separately because it is generally recognized in the profession as a separate system. In common with the dry rendering system previously discussed, cookers are used, of either vertical or horizontal design, often with modifications involving better means for solvent drainage from the cooker interiors. Several unit converter plants are using the cookers for solvent extraction, either on a full-time basis or for processing especially greasy materials, while continuing to use the unit converter system for regular operation, producing both tankage and extracted cracklings.

No presses are used in solvent extraction work, but the material before extracting must be hogged, and for reducing the extracted chips to commonly accepted size for feeding, hammer mills are used. The solvent stills and auxiliary equipment for handling the grease solutions and for recovering solvent are similar to those used in other extraction processes.

In one modern plant a blow tank is used to load the extractors with raw material. The extractors operate independently of each other, so that operation of but one unit will be de-



Horizontal dry rendering cooker in Tampa Soap Co.'s rendering plant at Tampa, Fla. Tank loading is done through a blow-case, with hogged material



Installation of French cookers, with enclosed receivers and percolators, in Detroit, Mich., plant of Detroit Rendering Co. An entirely closed system of dry rendering

scribed. The material is charged into the extractor through the blow line entering the top of the machine. The rendering or cooking operation is carried out in the usual manner, using a vacuum pump and jet condenser to aid the cooking and to control objectionable odors.

When the cooking is finished, any free running fat is pumped out through the built-in percolators in the cookers into the grease settling tanks. Solvent is then pumped from an underground storage tank into the extractor, where it is mixed with the cooked material and dissolves the grease. By use of proper valves, the same pump transfers the solvent solution of grease to closed settling tanks, where the fines settle out to be returned later to the extractor with a subsequent charge.

The material now remaining in the extractor, low in grease, but containing some absorbed solvent, is heated and agitated to distill off the solvent. A steam-distillation under vacuum is used to remove the last traces of solvent. The cracklings are then discharged and conveyed to storage ready for grinding or for sale as unground cracklings.

The solvent solution of grease is separated by the still, recovered solvent returning to storage for reuse. The grease is freed from the last traces of solvent by steam distillation, and conveyed to settling tanks.

To insure a vapor-tight system and low solvent losses, all vent lines from equipment not operated under vacuum are led to a scrubber device before being vented to the atmosphere.

The recovery of solvent and the distillation of grease solution is carried out simultaneously with cooking, but the two are described as separate operations simply for ease and clarity of presentation.

Solvent extraction offers all of the advantages of dry-rendering, and in addition easy control of residual grease in cracklings, and lower grinding costs because of the physical characteristics of the extracted cracklings. Another advantage shared with several dry rendering systems is the feasibility of using any and all sorts of raw materials in the same cooker charge.

With proper selection of solvent and careful operation, cracklings will not carry solvent odors. And by good construction and skillful operation, the fire hazard can be made almost negligible.

A rendery can easily attain a nearly perfect heat-balance when the proper relationships are set up in design among the various operating pressures used in the rendering process adopted, with consideration given the processing power requirements. The generation of power for the plant by high-pressure steam on its way to lower pressures for processing is being used in many renderies operating under all the various systems of rendering. In wet tank and unit converter plants, this use of steam power is very common, the exhaust from the engines going to the evaporators and heating coils in grease tanks, etc. The lower mechanical power requirements of dry rendering make possible the design of plants in this system for "byproduct power", even when one of the high-pressure cooking systems is chosen. This applies, also, to the solvent extraction systems.

Products of the fallen animal industry include hides, hair, wool, greases, tankage, cracklings, meat meals, and mixed feedstuffs for use in manufacturing and agriculture. All of these products are recovered from raw materials that are not only dangerous, offensive and obnoxious to handle, but potential health menaces, if not properly processed.

Some few of the greases are used for purposes in which their original physical or chemical properties find employment. Horse grease is notably of this type, and probably in the not too distant future the dead animal renderies will be called upon to avoid contamination of horse grease with other greases, if at all possible. The fatty acids from these greases may appear in the final products disguised somewhat, as for example, some may show up next as heavy metal soaps in lubricant compounds; some of our finest toilet soaps have this humble beginning, making use of the peculiar characteristics of part of the greases found in this class of soap stock.

Fluorescent Method Detects Leaks in Process Vessels

FRANKLIN CATLIN *Zyglo Division, Magnaflux Corp., Chicago*

Chem. & Met. INTERPRETATION

A new method for the detection of leaks in vessels, fittings, castings, valves, piping and other process equipment, without the use of pressure, is available in a fluorescent penetrant which is applied to suspected spots, and is then made visible in the event of a leak by near-ultra-violet light applied to the opposite side of the surface. It is claimed that the new method can detect leaks which may be undetectable by other methods.—*Editors.*

Use of a fluorescent liquid of high penetrating power for the detection of leaks in the seams of fabricated vessels, and through the walls of castings, is a new method* which is expected to have wide applicability. At present the method has been found to be effective on the seams of vessels of ¼-in. sheet metal, while a lesser amount of experience with thicker plate has indicated that good results may be had up to ¾-in. plate. On still thicker plate, or on castings more than 1 in. in thickness, difficulty in using the method has been encountered since the penetrant may become trapped or lost in a cavity or too-long channel beneath the surface which prevents the penetrant from finding a through path within a reasonable time. Some work with the method on piping systems for pressure and high vacuum has indicated its usefulness in this connection, while excellent results have been obtained in the location of leaks in other high vacuum devices such as electronic tubes.

Heretofore the methods available for the detection of leaks in vessels have included only visual inspection, air pressure and water pressure testing, and the use of liquids of low viscosity and surface tension, such as kerosene, either with or without pressure. These methods required the penetration of a considerable amount of the test material to insure the visibility of the leak.

Furthermore, for the greatest sensitivity, they required the use of pressure, and thus were difficult if not impossible to use except with closed equipment.

With the new fluorescent penetrant method, only an extremely minute amount of leakage is needed for good visibility, since the test liquid fluoresces strongly under the near-ultraviolet or "black" light which is used for its detection. Since the penetrant has excellent penetrating power, it need only be painted, squirted or sprayed on to one surface of the suspected joint or casting, without the use of pressure. After a lapse of 5 to 20 minutes the opposite surface is inspected with a portable hand-grip black light, any leaks being brilliantly marked by fluorescent spots or spreads. Very fine pinpoint spots can be further developed by the use of a developing powder which is applied to the surface by means of a hand bulb and by capillary action draws more of the penetrant to the surface, thus giving a larger fluorescent spot. After a leak is detected, the excess penetrant can be wiped off and the spot rewelded.

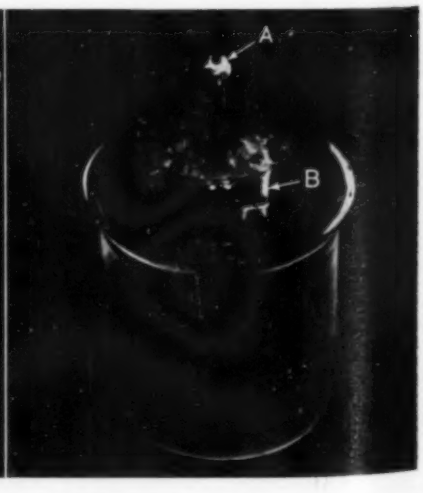
The color of the penetrant used is important since it must contrast well with the natural green and blue fluorescence of machine oils, fluxes, etc., often found on equipment and parts to be tested. The standard penetrant gives a yellowish-green fluorescence, while a red type is available for special applications, particularly for leak detection in vacuum tubes made of green-fluoreseing glass.

Unless extremely long seepage time is allowed, the older methods of testing frequently miss the smallest leaks. For example, a manufacturer of open tanks for holding a thin oil formerly used kerosene for testing and often had the experience of finding leaks in the final inspection after a tank had been painted and built into an assembly in which it was surrounded by electrical equipment. Fluorescent penetrant testing of these tanks is now used (as in one of the accompaning views), and completely eliminates any need for further repairs after final assembly, as well as greatly decreasing the necessary testing time.

Another case is in the manufacture of aluminum aircraft gasoline tanks, which were formerly tested by air pressure while the tanks were submerged in water. Frequently, tanks passed as perfect later allowed gasoline seepage in service, but this difficulty has been averted by the new testing method. In this case a few pints of the penetrant is poured into a tank which is rotated to coat the interior, after which the exterior is powdered and inspected. Vacuum tube manufacturers also are using fluorescent penetrant testing for slow leaks The tube is coated with the penetrant, which is then washed from the surface, and the glass inspected for penetrant which has passed into any cracks or holes which may be present.

Irradiating suspected seam which has been coated on the opposite side with fluorescent penetrant makes leaks readily visible as shown by spots in circles

Leaks in this vacuum tube are shown by the fluorescent method at (*A*), a cracked seal-off seal, and (*B*), a seam in a tungsten lead, causing a faulty seal



* The Zyglo leak detection process is available under an engineering service agreement and license which is covered by a fee in addition to the cost of equipment and testing materials. The Magnaflux Corp., sole licensee, provides instruction and follow-up service, as well as commercial inspection either in the field or at its laboratory.—*Editor.*

PLANT NOTEBOOK

CHART FOR ESTIMATING PERFORMANCE AND PRODUCTION RATES IN ROTARY KILNS

RALPH GIBBS *Consulting Engineer, York, Pa.*

THOSE in charge of rotary kiln operations frequently wish to check the performance of their operating units. In many instances there is little beyond their own data upon which to base comparisons, and generally such computations finally come to an end with the determination of the fuel ratio affording the chief interest.

It is true that fuel ratios are extremely important elements of operating costs. However, the production rate of a commercial rotary kiln unit also is important, and no doubt every rotary kiln operator is deeply interested in producing the maximum of suitable finished material, especially during these times of extreme demands for the war effort.

In making a study of those elements of rotary kiln operation which effect economies, the author previously presented an empirical formula for the optimum production rate of rotary kilns (*Rock Products*, November 1942, p. 58). This relation is $T_d = kD^2L/100$ where T_d is the tons of finished material per day; k is a constant, its value depending upon the kind and type of material being processed; D is the diameter of the kiln shell in feet; and L is the length of the kiln shell in feet.

In practice this relation is observed to hold rather closely for most sizes of kilns and kinds of materials. As an example, the author has had occasion to work with 6-ft., 7-ft., 8-ft. and 9-ft. diameter rotary kilns burning refractory dolomite granules. The accompanying table shows the average daily production of the various kilns.

Thus it has been determined that with the particular conditions under which these kilns are operating, the average value of k is approximately unity.

When we look for the factors which cause a variation in the optimum k they are not difficult to recognize. In the case of the 6-ft. diameter kiln, for example, the effect of internal rings and heavy coating is much more pronounced than it is on a larger diameter kiln. When the 6-ft. kiln is comparatively clean, it has been known to produce as high as 40 tons per day.

In the 7-ft. kiln k is improved over that of the 6-ft. kiln, but not quite so much as the k for the 8-ft. kiln for the reason just stated. The difference in production rate due to preheated secondary air is shown by the data of the two 8-ft. kilns.

The largest kiln tabulated seemingly is below its optimum production rate. This kiln, however, is operating with a different type of raw material which has a greater tendency to create rings and heavy coating than that with which the other kilns are working. This kiln has been known to produce 230 tons of finished material per day when all operating conditions were favorable, which is equivalent to a k value of 1.15.

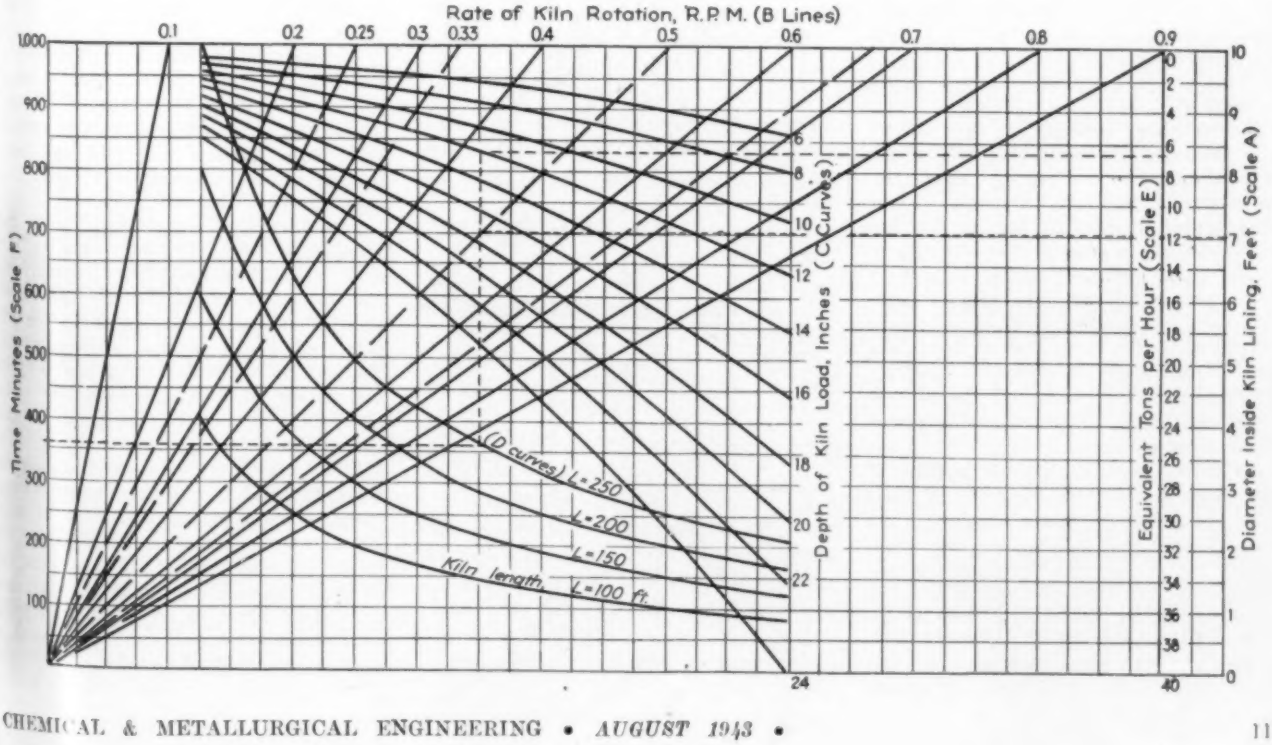
Thus it is fairly certain that k, under favorable conditions for producing hard-burned dolomite granules, is in the neighborhood of 1.15. In practice, however, it is best to assume practical operating conditions prevailing and therefore a k value of unity.

In the case where lime is burned in rotary kilns, this value of k is usually

Average Daily Production of Kilns Burning Dolomite Granules

Size of Kiln Dia., Ft.	Length, Ft.	Av. Daily Prod., Tons	Secondary Air for Combustion	Draft	Average k
6	110	30	Hot	Natural	0.76
7	115	60	Hot	Natural	1.06
8	125	90	Hot	Natural	1.12
8	125	80	Cold	Natural	1.00
9	250	210	Hot	Natural	1.04
				Average k	0.996

This chart makes it possible to estimate production rate and travel time in rotary kilns



increased, and practical operations have shown values as high as 1.50 for well-burned high-calcium lime.

In the burning or clinkering of cement, the relation still holds remarkably close, with a k value approximately that for burning lime.

A further aid in determining optimum rotary kiln production rates is derived from the empirical relations developed by the U. S. Bureau of Mines which has developed data on the rate of travel of material through inclined rotating tubes. In this work, the relation for unobstructed flow through the tube is

$$t = \frac{1.77L\sqrt{\theta}}{pdn}$$

where t is the time of travel in minutes; L is the length of the kiln in feet; θ is the angle of repose of the load material in degrees; p is the angle of the kiln inclination in degrees; d is the diameter inside the kiln lining in feet; and n is the kiln turns per minute.

The above relation is not sufficient unto itself to tell us about the production rate of the processing system. Therefore, to get results in terms of tons per hour or some equivalent rate, we must introduce the material quantity factors. This is done by further incorporating the unit weight and the volume of the material being processed.

Ordinarily, the unit weight of the material being processed is fairly constant. The volume per unit of kiln length, however, can vary between rather wide limits. In other words, the depth or thickness of the load or burden in the rotary kiln can be varied to suit the whims and fancies of the individual in charge of the operation. The optimum depth of load, however, can be determined for specific conditions of operation. In so doing, it is well to remember that the higher kiln speeds are not altogether desirable since high speeds are conducive to greater wear of moving parts, higher power costs, and serious "working" of the refractory lining. Furthermore, with light loading it is difficult to control over-heating with its consequent operating difficulties.

Nevertheless, considering the various kiln loadings, the production rate of the rotary kiln can be readily computed. In order to facilitate a study of the kind under discussion, the author has developed the accompanying chart.

The data upon which this chart is based are as follows: The kiln is unobstructed; the material being processed weighs 95 lb. per cubic foot of aggregate and has an angle of repose of 45 deg.; the inclination or slope of the kiln is $\frac{1}{2}$ in. per foot. This inclination seems to be most generally used.

To use this chart, the intersection of the Scale-A ordinates with the B lines fixes the points of intersection with the kiln-loading curves C and the kiln-length curves D, from which the equivalent production rate on Scale E and the time of passage on Scale F can be determined.

Thus, in the example shown by the dotted lines, a clean kiln with a diameter of 7 ft. inside the lining, turning at 0.5 r.p.m., with a load depth of 12 in. of material weighing 95 lb. per cubic foot and having an angle of repose of 45 deg., will produce the equivalent of 6.8 tons of the original material per hour. The time of travel through 250 ft. of kiln will be 360 minutes.

Necessary modifying factors are applied to the results thus obtained. Thus if the material goes through a decomposing process in the kilns, such as is the case in burning lime and cement, the output tonnage must be corrected by the proper factor to take account of the change in composition. For example, if 55 percent of the original material is discharged from the kiln as solid, recoverable material, then the actual production rate of the solid is 6.8×0.55 or 3.7 tons per hour.

Referring back to the tabulation we see that all these practical considerations bring results in close agreement.

Logarithmic Modulus Chart For Root and Power Calculations

JOSEPH D. PARENT

Department of Chemical Engineering, Kansas State College, Manhattan, Kan.

MODULUS CHARTS with logarithmic scales, such as are given on p. 257 of the second edition of Perry's "Chemical Engineers' Handbook" (McGraw-Hill Book Co., 1941) are widely used for marking off the axes for log-log types of graphs and the scales of some types of nomographs. The purpose of this article is to point out an interesting property of such a chart, namely that it, itself, can be used for making certain types of calculations.

In exactly the same manner as square and cube roots (or powers) are determined with a slide rule, so can any root or power of a number be determined with the aid of a logarithmic modulus chart. This is because the chart has, in effect, an indefinitely large number of scales of different moduli instead of the one-, two- and three-cycle scales of the simple slide rule. (See D, A and K scales of any polyphase rule.)

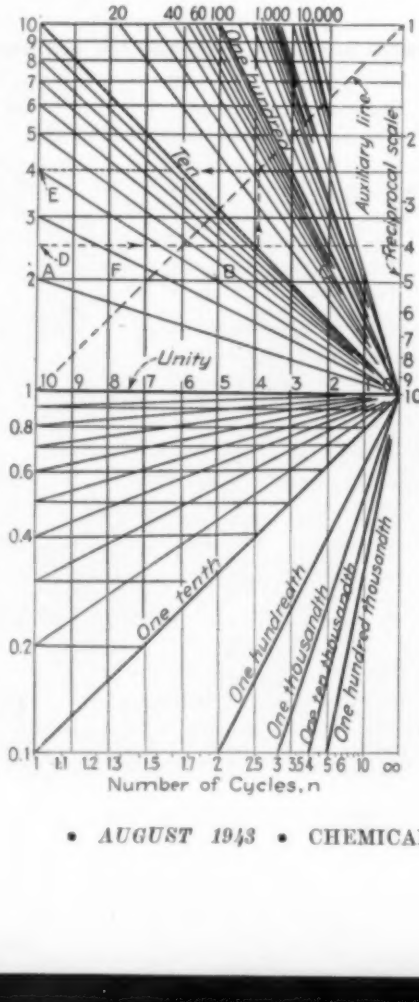
Referring to the accompanying chart, it may be seen that where the abscissa is marked 5, there is a vertical two-cycle scale; where it is marked 2 there is a five-cycle scale; at 4 there is a two-and-one-half-cycle scale, etc. Coming horizontally across from point A on the one-cycle scale to point B on the two-cycle scale, one may read off the square of the number represented by the point A; conversely in going from B to A one reads A as the square root of B. The point C on the five-cycle scale represents the fifth power of A and, of course, A is the fifth root of C.

Reciprocals can be read off a scale which is marked off in the same way as the original scale, but which is oppositely directed. That is, the modulus of a reciprocal scale is to have the value of minus one. Another method of accomplishing this is shown by the dashed diagonal auxiliary line which has been added to the chart. In the diagram, it is evident that $\log D + \log E = \log 10$, or $D = 10/E$, so that the two quantities stand in reciprocal relation if the decimal point is moved one place to the left. The dotted line originating at D on the chart shows, by means of the diagonals, that E divided by 10 is the reciprocal of D, and vice versa.

In order to determine reciprocals by the first method, one can use a single line as shown at the right of the diagram, and this will be equivalent to the slide rule method. It will be useful in determining what scale to use. Thus if one wanted the 1.25 power of a number he should go horizontally from this number on the left-hand scale to that scale which has 1.25 cycles, namely the one whose abscissa is 10/1.25 or 8. Point F in the chart represents the 1.25 power of A. In general, $10/n$ gives the abscissa of the scale which has n cycles and either the auxiliary-line or reciprocal-scale method can be used for this evaluation.

The lower part of the chart is unnecessary and is given only for convenience, since roots and powers of fractional numbers can be handled on the upper part by proper attention to the decimal point. The modulus chart has thus been shown to be useful in rapidly estimating any root or power of a number, and should be of service in the absence of a log-log slide rule or tables.

Logarithmic modulus chart can easily be used for determining roots and powers



CHEM & MET REPORT ON . . .

Industrial Alcohol for War and Postwar

Alcohol, our oldest and most guarded chemical, has now "mushroomed" into an industrial commodity many times its former importance. Tonnage-wise, industrial alcohol is number one in the entire organic chemical field and it is now running neck to neck with conservative caustic soda. As the common meeting ground (and sometimes battle ground) for political, agricultural and chemical engineering, the industrial alcohol industry bears some of the earmarks and a few of the scars of all these diversified fields. Although the industry itself is dignified and satisfied with a peaceful role, it has recently found itself to be so much molasses to every political fly on the wing. As a result, since Pearl Harbor it has been jockeyed into countless problems involving petroleum raw materials, synthetic rubber, more tax experts, beverage distilleries, tankers and tank cars, the explosives program, sugar shortages, the anti-freeze market, sawdust and sulphite waste liquors, feed for cattle, stream pollution and Congressional committees around every Washington corner.

In spite of such diversions the industry, with the aid of the beverage distilleries and through excellent government-industry cooperation, expects to achieve by the end of the next fiscal year a 370 percent production increase over 1940 with a minimum of critical materials requirements. This is the story, told briefly and without bias, of the recent vicissitudes of the industrial alcohol industry, what it has done for our war effort and what it can do for our postwar economy.

WITHIN the last year or so, the demand for industrial alcohol in this country has been multiplied several fold over the peak of peacetime needs. Manufacture of explosives and the production of butadiene for synthetic rubber naturally represent the two largest of the new demands, although it is also true that practically all normal industrial users have required more alcohol for their ordinary purposes because of expanded wartime activities.

RISE IN DEMAND

In prewar years the need for industrial alcohol ranged from about 110 to 140 million wine gallons* per year (190-proof basis), the total need being determined largely by general business conditions. Major uses of industrial alcohol in late prewar years are shown in Table I.

However, even before this country entered into the shooting war the influence of an increased demand by war industries was felt in the alcohol business. Manufacture of explosives in the United States for the British government represented one of these large increases in requirements which merely foreshadowed the war activities of our own government. The general stimulus to chemical manufacturing which came from diversified war business produced many other such increases, indirectly, of course. At present the largest strictly chemical manufacturing uses for alcohol are as a raw material for preparation of acetaldehyde, ethyl chloride, and ethyl acetate.

Most of us can recall when alcohol was much more dominant in the field of anti-freeze for motor cars. In fact, even as late as the fiscal year ending June 31, 1936 the anti-freeze market was the largest single consumer of industrial alcohol, although during recent years its control of that market has been challenged both by non-evaporating anti-freeze based on glycol and by methanol. Well in advance of Pearl Harbor it became increasingly evident that the United States would find itself very short of anti-freeze unless something drastic could be done to increase production of alcohol. It was partly this effort in behalf of the motor car which gave the running start on alcohol for synthetic rubber which has proved so valuable during 1942 and 1943.

Even before this alcohol demand became pressing, the military and industrial demand for glycol had already begun to take that chemical away from the motorist. In addition, the manufacture of methanol for anti-freeze was interfered with in two ways. Some of the high-pressure equipment was changed from methanol manufacture to ammonia synthesis, since at that time there was a threatened shortage of ammonia for explosive purposes. At the same time new demands for methanol for formaldehyde and other uses in industry took away still more from the anti-freeze market.

As a consequence it became necessary

*A wine gallon is a measure containing 231 cu. in. of any proof (strength) of alcohol. A proof gallon of alcohol-water solution contains 50 percent by volume of alcohol and, by definition, this solution is called "100-proof." A solution containing 95 percent alcohol by volume is usually referred to in industry as "190-proof alcohol." One wine gallon of 190-proof alcohol is equal to 1.9 proof gallons.

Table I—U. S. Actual Supply and Consumption of Ethyl Alcohol for Fiscal Years 1936-7, 1940-3, With Estimated Supply and Requirements for Fiscal Year 1944[1]

(Millions of Wine Gals., 190-Proof)

	1936	1937	1940	1941	1942	[2]1943	Est. 1944
Supply							
Synthetic & Misc.	17.4	18.9	32.9	37.2	48.1	52.7	60
Molasses	78.5	88.8	88.0	109.5	152.2	84.9	[7]40
Grain—Industrial[6]	7.3	9.8	7.4	2.9	3.6	35.2	160
Beverage Distilleries	[3]0.9	[3]7.0	[3]0.1	19.6	53.9	152.4	235
Redistilled High Wines	.....	.....	.....	.....	2.5	44.9	10
Total Production	104.1	124.5	137.4	169.2	260.3	370.1	505
Imports	.....	.....	.....	.....	.....	4.9	15
Total Supply	104.1	124.5	137.4	169.2	260.3	375.0	520
Consumption							
Direct Military & Lend-Lease	.....	.....	0.0	[4]6.7	49.4	94.8	115
Synthetic Rubber	.....	.....	.....	.....	.....	22.6	265
Chemical Mfgr.	27.6	34.4	57.8	70.7	74.0	[4]76.0	80
Anti-freeze[5]	35.7	23.5	19.4	21.2	36.6	27.8	40
All other	42.6	58.1	63.7	71.6	94.1	[4]50.9	50
Total Consumption	105.9	116.0	140.9	170.2	254.1	272.1	550
Stock Pile (end of period)	.....	.....	.....	.....	6.3	114.9	85

[1] Actual data from reports of Alcohol Tax Unit, Treasury Dept. Estimates from Chemical Division, War Production Board, July 16, 1943.
[2] Preliminary.
[3] High-proof spirits.
[4] Estimated.
[5] Includes completely denatured and specially denatured. All completely denatured is assumed to have been used for anti-freeze but this is not entirely true.
[6] For 1936, 1937 and 1940 data are not strictly comparable with later years because output of distilleries while operating under industrial permits is included with industrial production for these three years and with distillery production for later years.
[7] Estimate based on present outlook of molasses shipping situation vs. availability of grain. In the event that ships are available to import more molasses, production from this source will be higher and production from grain will be lower.

for alcohol to reoccupy the anti-freeze field, some of which it had lost in previous years. Otherwise the motor cars of the nation would have been laid up for want of anti-freeze even before the gasoline and tire shortages became determining factors. The major results of these changes in demand and supply are quite evident in the 1942 requirements for alcohol for purposes normally called non-military.

FOR SMOKELESS POWDER

First of the large direct war demands for alcohol came during 1940-41 from the explosives program. In the manufacture of smokeless powder, about 0.2-0.3 lb. of alcohol are required for each pound of smokeless powder manufactured, the actual amount consumed depending to a large extent upon the efficiency of the solvent recovery system. This alcohol acts as a partial solvent or gelatinizing agent. Now smokeless powder is the largest single direct military user of alcohol, although substantial amounts have been going into such chemical warfare gases as the mustard compounds. Lend-Lease to Great Britain and Russia is another important factor in the present direct military needs for industrial alcohol.

Present demands for direct military and Lend-Lease alcohol are at about 95 million gallons per year. This is increasing and will probably represent 115 million gallons for the fiscal year 1944, or some 20 percent of the estimated total distribution, even though the demand for smokeless powder will not be as great as previously estimated. The postwar problem of this alcohol will be discussed later in this report.

FOR BUNA S

When the manufacture of synthetic rubber suddenly became necessary in this country there were two major processes available for production of the butadiene raw material. This chemical could be made either from petroleum or from alcohol. Much of the confusing controversy during 1941 and 1942 on the rubber program had to do with the relative merits of the alcohol and other methods; and undoubtedly there has been some use of politics to misrepresent engineering facts. Nevertheless, even before the Baruch Committee crystallized the synthetic rubber plan, it had been decided that a large quantity of our Buna S requirements would be made from butadiene manufactured from alcohol.

At various times the estimates of the quantity of alcohol which would be used in butadiene production have varied considerably. But the actual Buna S program now operating requires that from 220 to 240 million gallons of alcohol will be so employed each year. Experience indicates that about 2.2 lb. of butadiene can be made from a gallon of 95 percent alcohol. This corresponds to roughly 2.5 lb. of Buna S rubber from a gallon of alcohol. There are at the present time three plants scheduled to use alcohol for butadiene manufacture located in West Virginia, Pennsylvania and Kentucky. The rated capacities of these alcohol-butadiene plants is some 220,000 tons, or about 34 percent of the total butadiene program.

Consumption of alcohol for synthetic rubbers represented only about 8.5 percent of the total alcohol used for the fiscal year 1943, but this is expected to increase to about 50 percent of the total distribution for the present fiscal year. By that time, synthetic rubber will be by far the largest single consumer of industrial alcohol in this country and will be taking more alcohol than was produced from all sources during the entire fiscal year 1942! This, of course, also includes that alcohol which goes into the manufacture of ethylene for styrene, as well as butadiene.

The only commercialized method in this country for converting alcohol to butadiene has been developed by Carbide & Carbon Chemicals Corp., which has three plants now operating or under construction. Already operating are the plants at Institute, W. Va., and Pittsburgh, Pa., while the smaller unit at Louisville, Ky., will probably begin operating during September of this year. A number of other processes for converting alcohol to butadiene are under various stages of development by other concerns, but these have not yet played any important role in the synthetic rubber picture (for details of processes, see *Chem. & Met.*, pp. 97-100, Dec. 1942 and 94-97, Jan. 1943).

Alcohol for the Institute plant, which has four units for production of butadiene, each designed for a capacity of 20,000 short tons, is derived mostly from fermentation of grain. To supplement this, alcohol made from molasses and some synthetic ethanol from petroleum gas can also be used when in an emergency. For a detailed description of the Institute plant see *Chem. & Met.* pp. 98-102 and 140-143, June, 1943.

SOURCES OF ALCOHOL

Prewar supplies of industrial alcohol were made principally by fermentation, largely with West Indian blackstrap molasses as raw material. In the fiscal year 1937, for example, over 70 percent of the domestic supply of industrial alcohol came from blackstrap molasses, which normally contains between 50-55 percent sugar by weight, and from "high-test" molasses, which may run as high as 78 percent total sugars.

Second major source at that time, representing some 15 percent of the total supply, was synthesis from unsaturated hydrocarbons separated out of petroleum refinery gases or ethylene from other hydrocarbon cracking. A number of very minor raw materials or sources of alcohol also existed. Table

I shows the supply of alcohol by sources for the fiscal years 1936-37 and 1940-43. A glance at this shows at once the rapid growth of the synthetic processes as well as the vicissitudes of the molasses-grain raw material situation from year to year. Most important of all, however, is the remarkable conversion job that has been done by the beverage distilleries, who will soon be producing almost 50 percent of the domestic alcohol supply. Conversion problems of these plants will be discussed later.

MOLASSES SHORTAGE

The critical shortage of tank ships had its influence on the imported molasses supply for alcohol plants even before Pearl Harbor. These tankers were so much more urgently needed for petroleum transport and the submarine hazard became so serious that they necessarily were taken off Cuban and Puerto Rican molasses runs. The immediate effect was a simultaneous slowing down of alcohol manufacture and a vigorous search for alternative raw materials.

Raw sugar, available in both Cuba and Puerto Rico at relatively low cost, could be brought in vessels that could not handle any liquid cargo like molasses. Alcohol plants along the Eastern Seaboard, therefore, began to use raw sugar for fermentation. That activity, of course, accelerated the developing shortage of household sugar and led to one of the sourest situations affecting a sweet commodity that America has ever experienced.

In 1940 and 1941 actual allocation of raw sugar as a molasses substitute was undertaken. When sugar rationing threatened and the sugar shortage at the grocery store was obvious to every housewife, this diversion of sugar became highly objectionable from the public point of view. Nevertheless, some 1.3 million tons of raw sugar per year were allocated for alcohol plant usage in the tentative plans for 1941-42. Fortunately, about two-thirds of this raw sugar was later shifted to sugar refineries and alternative raw materials were supplied for alcohol manufacture.

Meantime, all of the Insular sugar-growing areas began to experience a serious difficulty in molasses disposal. That difficulty still continues, and the amount of molasses now available in the West Indies has been estimated in the neighborhood of 325 million gallons, equivalent to as much as 150 gallons of 190-proof alcohol. This amount of molasses represents about the same gallonage used for alcohol production for the fiscal year 1942.

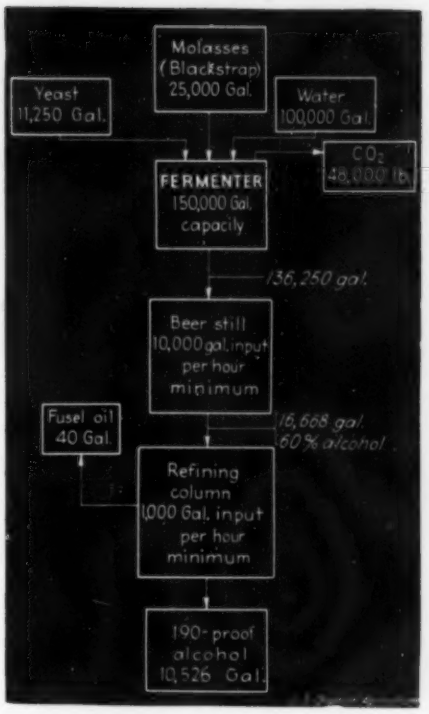
This surplus molasses has already over-taxed available storage capacity, and at the present time it is simply being run out into pits in the ground where it often actually becomes a public nuisance, worse than a waste by-product. Plans for the utilization of this surplus molasses are now being made, and it is possible that the improved shipping situation will soon again allow tankers to haul molasses to our Seaboard alcohol plants.

FROM CORN TO WHEAT

Even as the molasses shortage developed, the various industrial alcohol plants were being shifted gradually from all-molasses to a combination of molasses and corn. Probably as much as 60 percent of this conversion from molasses to grain was completed during 1942. The use of 100 percent corn was first suggested, then the use of mixtures of corn and wheat because of foreseeable shortages in the supply of corn available for alcohol production. As of the early part of 1943, about 75 percent of the grain used came from the Commodity Credit Corp. and was about 50-50 wheat and corn. Latest plans called for the use of over 150 million bushels of grain, mostly wheat, for alcohol production in 1943.

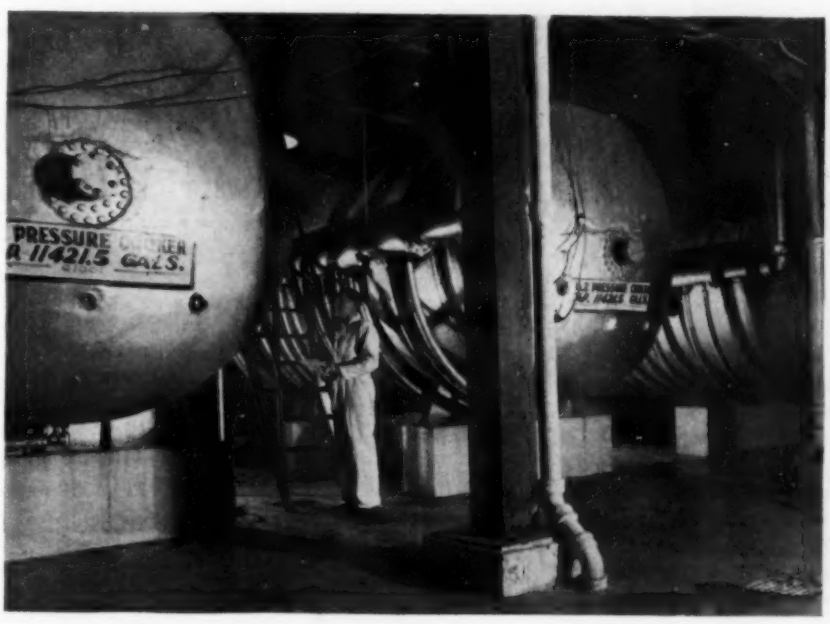
During the last few months still another shift has been under way from corn to all-wheat. Late in 1942, experimental runs were being made with granular wheat flour or "wheat grits" milled from wheat in order to replace whole wheat for alcohol fermentation. Use of corn in manufacturing distilled spirits and high wines was finally prohibited by WPB on July 10, 1943, to conserve the dwindling stocks of corn for other essential purposes, including starch and butyl alcohol. The actual saving of corn effected by this restriction, however, is believed to be small because the beverage producers had already shifted largely to wheat.

Technology for corn processing had long been known, particularly because of alcoholic beverage operations. However, relatively few industrial alcohol plants had used corn, and practically


Molasses (Blackstrap) 25,000 Gal.
Yeast 11,250 Gal.
Water 100,000 Gal.
CO_2 48,000 lb.
FERMENTER 150,000 Gal. capacity
136,250 gal.
Beer still 10,000 gal. input per hour minimum
Fusel oil 40 Gal.
16,668 gal. 60% alcohol
Refining column 1,000 Gal. input per hour minimum
190-proof alcohol 10,526 Gal.

Generalized flow sheet for one conventional method of making alcohol from blackstrap molasses

Whiskey distilleries making war alcohol cook the grain mash in such pressure vessels here shown in a Schenley plant before pumping it to the fermenters



Looking down upon a huge "beer well" where fermented liquid from grain mash and yeast is collected and pumped to the stills to make 190-proof alcohol

none of them had ever used wheat heretofore. Hence, the shift from molasses involved new techniques and process controls. This change-over has been greatly aided by work of the Wheat-Alcohol Research Committee.

Just a few months ago there were in operation 121 distilleries and 10 industrial alcohol plants which process grain in some form. A few of the industrial plants handled granular wheat flour only. Seventeen additional industrial alcohol plants, largely in the New Orleans area, still handled molasses only, but both raw material and equipment changes were still rapidly being made in the industry.

As contrasted to the use of whole grain, the granular flour process developed in 1942 is considerably simplified. Mashing is easy because the flour goes into slurry quite readily. Cooking can be carried on at atmospheric pressure and conventional molasses fermenters and distillation equipment can be used with few or no changes. Carbon dioxide can be recovered from the fermenters just as in production from molasses. In addition, slop disposal equipment is considerably simplified, and in some cases can be eliminated completely.

A bushel of wheat weighing 60 lb. makes approximately 40 lb. of this granular wheat "grits" high in starch. The process of milling separates out the bran, germ and most of the non-starch components of the kernal, and hence most of the material that would become slop in the whole grain process is removed as salable bran. The 20 lb. of such material is not wasted in the fermentation industry, but can be recovered to give a feed equal in value to corn for animal use.

According to one report, use of granular wheat flour should yield approximately 2.8 wine gal. of alcohol per 56 lb. of granular wheat flour as compared to an average yield of approximately 2.6 wine gal. of alcohol per 56 lb. of whole corn, and about 2.4 wine gal. per 56 lb. of whole wheat.

ALCOHOL FROM DISTILLERIES

The beverage alcohol industry falls into two distinct classifications: those plants with facilities to make 190-proof alcohol and those with facilities to make only "high wines" or 120–140 proof. When anti-freeze alcohol was needed in 1940, one of the possible sources considered was the whiskey distilleries and other alcoholic beverage plants. It was obvious that those distilleries with equipment for making 190-proof alcohol could make this for industrial purposes quite as well as for beverage use.

During 1940, plans first began to take shape for converting these beverage distilleries in order to make them a part of the industrial alcohol program. This conversion program has gone on steadily ever since through the splendid voluntary cooperation of the beverage industry. By February 1942, the 190-proof beverage plants were already engaged full time in the production of alcohol for war uses, and many of the "high wine" plants were shipping their low-proof alcohols to industrial plants for rectifying into 190-proof material. This continued on a rising scale throughout the year, and by October the entire production of "high wines" was being shipped to redistilling plants. Thus the nation's entire distilled spirits industry was put into the service of the war effort.

Object of this conversion program was production of the necessary amounts of alcohol without using critical materials to build new equipment. The necessity for this was demonstrated simply by the fact that 215 tons of steel, 140 tons of cast iron, 13 tons of copper and alloys, as well as other materials, are necessary for the construction of a wartime grain plant that will turn out 2.5 million gallons of alcohol a year. It is estimated that a synthetic plant would require three or more times as much critical materials.

One of the most difficult problems faced was that of arranging for transportation of "high wines" from whiskey distillers to industrial alcohol plants for rectifying. Low-proof alcohol had previously been sold in barrels or smaller containers at the distillery, and had not been moved in bulk.

Notwithstanding the difficulties involved, a total of four million gallons of "high wines" were transported from distilleries to industrial alcohol plants during the first six months of 1942, and the program for the last half of that year called for the movement of eight million additional gallons. For the fiscal year 1943 some 45 million gallons of 190-proof alcohol were produced from redistilled high wines, but this figure is expected to drop to about ten million gallons for the coming fiscal year. Table II shows the approximate production and consumption distribution by geographical areas.

It may be stated, in passing, that the conversion of breweries to alcohol distilleries is generally found by experience as impractical. The same is true for the use of sugar refineries for the same purpose. In other words, it is found to be cheaper and quicker to build new alcohol plants of modern design, taking full advantage of recent developments in lowering the amount of critical materials, than it is to convert breweries or sugar refineries.

By November 1942, about 45 beverage plants were reported to be producing industrial alcohol, and it was anticipated that about 60 more such plants would be converted by about the first of this year. This would leave, at the completion of the conversion period, only about 25 plants producing "high wines" that would have to be shipped to other alcohol plants for distillation. At that time it was estimated that only about seven of the 60 beverage distilleries still on the conversion program would require any appreciable new equipment.

This change-over from distilled beverages to industrial alcohol first contemplated the use of corn as raw material. Later, the corn shortage affected

Table II—Approximate Production and Consumption of Alcohol in the United States

Location	Production Percent of Total	Consumption Percent of Total
Atlantic States.....	57.5	57.8
Southern & Gulf States	20.0	19.4
North Central States.	15.5	17.3
Midwest & Southwest.	4.9	3.1
Pacific Coast States.	2.1	2.4

plans at the beverage plants, and these now have been ordered onto a wheat-only basis. In some cases whole wheat is used, in other cases granular wheat flour. In all cases, however, recovery of feed is maintained because of the urgency of getting the maximum high-protein by-product for animal use.

The invaluable contribution of the beverage industry to the war alcohol picture is shown by the fact that beverage distilleries and "high wine" plants have contributed 197 million wine gallons of 190-proof alcohol for the fiscal year 1943 and will contribute an estimated 245 million gallons for the fiscal year 1944. This is approximately 53 and 49 percent respectively of domestic production from all sources. The rapidity of this conversion is illustrated by the fact that only 22 percent of domestic industrial alcohol production came from this source in the fiscal year 1942, and only 12 percent for the fiscal year 1941. The breakdown between beverage 190-proof alcohol and redistilled "high wines" is shown in Table I.

NEW WHEAT PROCESS

Recently A. K. Balls and I. W. Tucker of the Department of Agriculture research staff publicized a method for converting granular flour to fermentable sugar (see accompanying flow sheet). The basic principle of this process is to separate the cracked wheat into three components, starch, diastase and proteins, by mixing the flour with a 0.05 percent solution of sodium sulphite.

After addition of the sulphite the mixture is agitated for a few minutes, water is added, and it is then allowed to settle. An 85 percent protein concentrate rises to the top while the starch settles to the bottom, leaving a diastase liquor in the middle. After the protein and liquor are removed, the remaining starch contents are cooked. The diastase liquor, which is the converting agent or enzyme, is added to convert the starch into sugar, which is then fermented into alcohol and put through a still in the usual manner.

Use of this diastase may eliminate the necessity of adding a large portion or even all of the barley malt, an expensive ingredient. This natural diastase in wheat is ordinarily destroyed by the cooking process which precedes the conversion step and is therefore not available in present distillery operation.

For present purposes, the recovery of the protein may possibly outweigh other advantages of the process. According to some estimates, wheat may be used in alcohol production at a rate of over 150 million bushels a year. From this amount of wheat, the sulphite process could yield over a million pounds of a dehydrated high-protein product, since experiments indicate that about 8 lb. of protein material per bushel of wheat can be obtained. If this material can be handled and dried satisfactorily and without too much expense, a large amount of protein for livestock feed may be made available before distillation instead of being recovered from distillers' slop as at present. Possibly some of the protein might even find use as human food.

This new process is now being tried out experimentally on a plant scale at several large distilleries. Preliminary reports appear promising, but a number of technical problems undoubtedly remains to be solved before commercialization of the process will be considered seriously.

SYNTHETIC ALCOHOL

Manufacture of alcohol from byproduct hydrocarbon gases has been carried out in the United States by Carbide & Carbon Chemicals Corp. and by Standard Oil Co. for a number of years. The conventional process is to absorb ethylene, the usual raw material, in strong sulphuric acid and then hydrolyze this ester into ethyl alcohol.

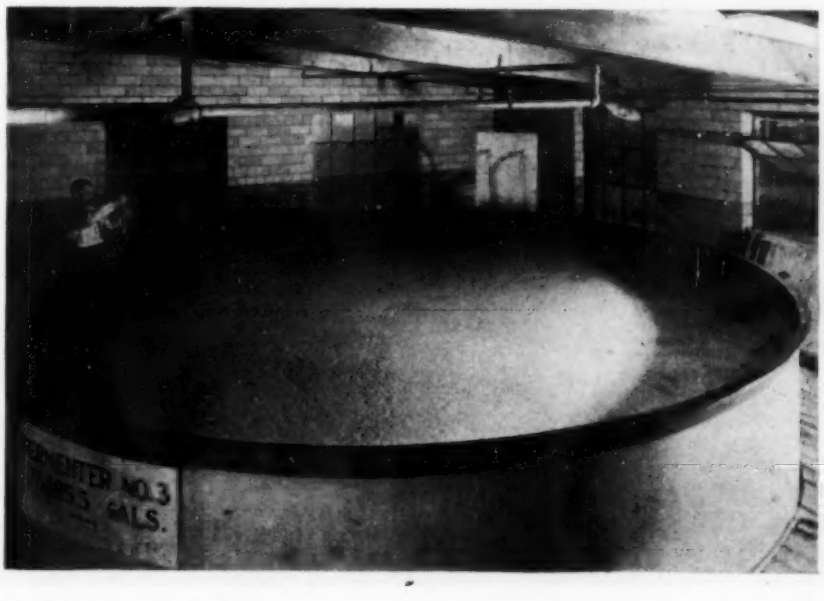
Ethylene gas is available and expansion of this type of facilities is technically feasible and might easily have been arranged by the government officials. However, the requirements for corrosion-resistant equipment and for complicated engineering machinery used in such synthetic plants made such a program very undesirable in wartime. Equipment of this sort, which would require large quantities of steel plate, carbon steel, cast iron, etc., had to be reserved for facilities to manufacture high-octane aviation gasoline, butadiene and other chemicals which, unlike alcohol, cannot be made with old-style and existing facilities. However, some expansions in present facilities for producing synthetic alcohol have occurred in present plants and this country is now believed to be turning out synthetic alcohol at the rate of about 50–60 million gallons annually as compared to about 35 million gallons for the fiscal year 1941.

SULPHITE LIQUOR ALCOHOL

One new technique being studied by the government for manufacture of alcohol from wood provides for fermentation of carbohydrates in the waste liquors from sulphite pulp manufacture. One Canadian plant is now operating commercially at Thorold, Ont., and provides both the United States and Canadian authorities with the first full-scale trials of this process on this continent.

Developed by the Ontario Paper Co., the Thorold plant was officially opened in June. Output was originally esti-

Grain mash and yeast react in these huge tanks at a Schenley beverage plant to form "distillers beer," from which war alcohol is now extracted



mated at 600,000 gal. of alcohol annually, but this figure has probably been increased to over 800,000 gal. It is likely that reducing the fermentation period to as low as 24 hours' cycle will increase the capacity even further. The process, used extensively in Europe since about 1936, utilizes the 1–2 percent fermentable sugars in the sulphite waste liquors.

The 1941 production of the 80 sulphite mills of the United States was 2.9 million tons of sulphite pulp. At a reasonable estimate of 12 gal. of alcohol recoverable from the waste liquor per ton of pulp manufactured, this is equivalent to about 35 million gallons of alcohol. Many mills of small capacity probably cannot support an alcohol plant, but it has been estimated that a mill with a daily capacity of 175 tons of pulp or more can support an alcohol plant of economic size. There are 17 such mills in the United States with a combined capacity of about 1.4 million tons a year. At 12 gal. per ton, their annual alcohol producing capacity would therefore be 16.2 million gallons.

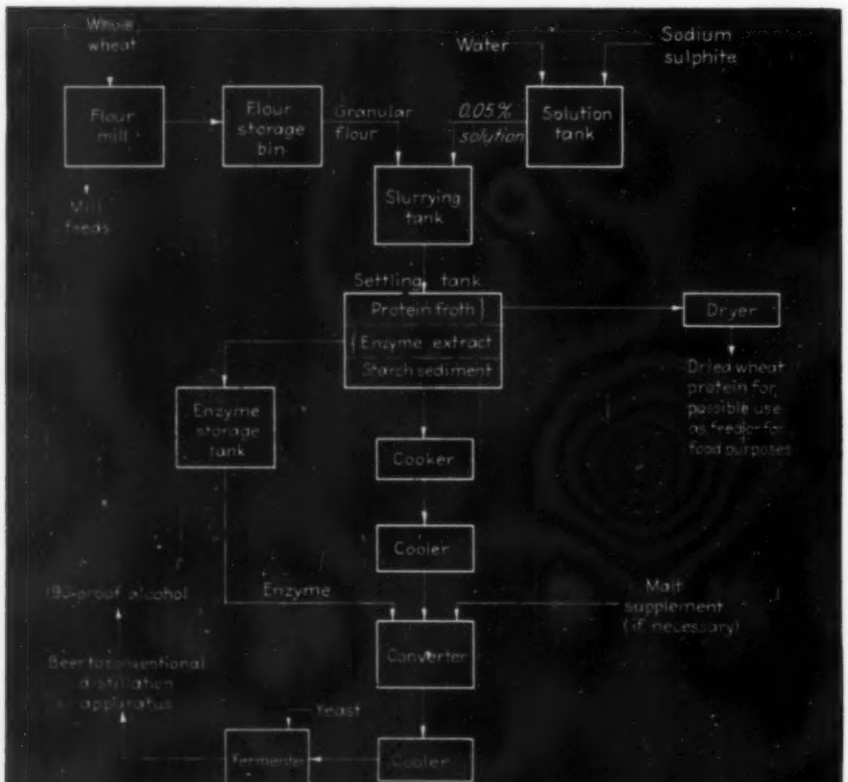
Production of alcohol from sulphite waste liquor is technically simple. Sugars are produced from the cellulosic and hemicellulosic fractions of wood as a byproduct of the pulping operation. Approximately three-fourths of the sugar produced is fermentable by ordinary yeasts. In general, the production of a ton of pulp is accompanied by approximately 1,200 gal. of waste liquor containing about 190 lb. of fermentable sugar. Theoretically, this should yield 16.3 gal. of 100 percent alcohol, but actually a yield of 12 gal. per ton of pulp appears to be practicable.

In processing, the waste pulp liquor is aerated to remove free sulphur dioxide, cooled, limed to raise the pH to about 6, separated from sludge, fermented and distilled. Improved processes of fermentation reduce the former 72-hr. fermentation to about 48 hr., with considerably increased yields. A generalized flow sheet for this process is shown in an accompanying illustration.

An important item in the production of alcohol from sulphite waste liquor is steam consumption, which is high because of the dilute alcohol solutions obtained. In general, 80 lb. of steam may be required for the distillation of a gallon of 190-proof alcohol from a feed liquor of 1 percent alcohol.

It has been estimated by the Ontario Paper Co. that the production cost of alcohol from their plant at Thorold will be about 20 cents a gallon on a basis of a 10-year amortization of plant cost. It has been estimated that in the United States, operating costs alone, eliminating overhead and amortization, would run between 10 and 12 cents per gallon. Another company has estimated that it can make alcohol by this process at 18 cents per gallon, using a 20-year amortization of plant cost as a basis. This latter estimate was based upon a plant to produce 1,764,000 gal. of 190-proof alcohol per year, according to testimony before the Gillette Committee.

Here is the probable line of processing for an alcohol plant using the Balls-Tucker sulphite grain process now undergoing intensive development tests



WOOD HYDROLYSIS

Some years ago two companies in the United States undertook to study the manufacture of alcohol by fermentation from carbohydrate material derived directly from wood. Neither development had any commercial success.

As a matter of insurance, however, it seemed to the Office of Production Research & Development that further knowledge of these possibilities should be accumulated for emergency use. The hope is that methods which are technically feasible may be developed promptly so that if a grain or other raw material shortage becomes acute it will be possible to consider without delay sawdust or other wood waste as a source of fermentable sugar. Wood hydrolysis processes, especially the Scholler-Tornesch method, have been used to a large extent in Europe.

In order to obtain the necessary basic engineering knowledge for construction of a wood-sugar plant utilizing the Scholler process, three contracts were arranged by WPB through OPRD. Two of these contracts are with Dow Chemical Co. and Tennessee-Eastman, providing for the use of their development facilities. The third arranges for the engineers of the Forest Products Laboratory to carry out studies at Midland, Mich., and Kingsport, Tenn. Even though these results may not develop into processes of economic significance, the facts obtained will provide a reserve of technical information to be used in emergency.

Essentially, the processes involved provide for acid treatment of sawdust under pressure to convert cellulose into fermentable sugar. Either sulphuric acid or hydrochloric acid may be employed. A technical report on the possibilities of both the Scholler and the American processes was given by Dr. J. A. Hall of the U. S. Forest Service and a member of the Wheat-Alcohol Committee before the Gillette Committee during the early part of this year.

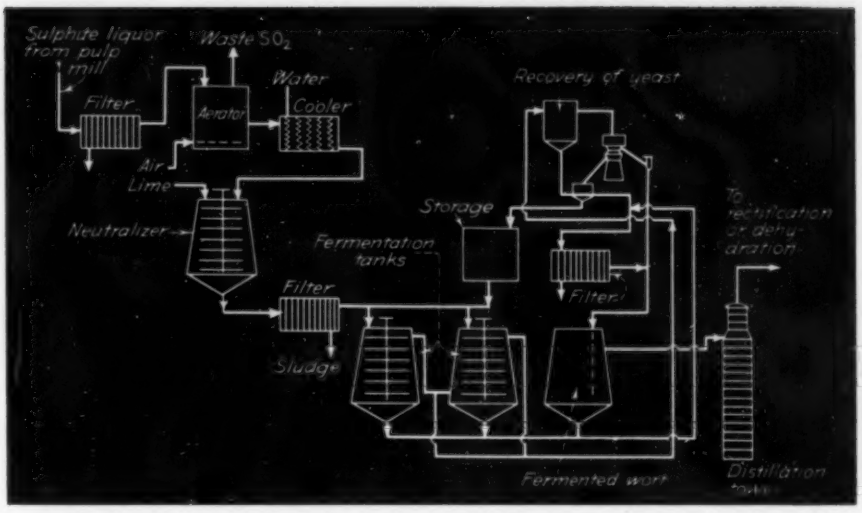
CRITICAL MATERIALS

In any study of the alcohol problem in wartime it is very important to remember that normal cost considerations are definitely secondary. Far more important in the determining of govern-

ment policy is the question of required metal and machinery. The process which will work without steel, copper, or new accessory equipment like boilers has a great military advantage over other processes that need these critical materials.

As a result of this unusual yardstick of desirability, much new construction has been definitely "makeshift" engineering. Fermenters, storage tanks, and even other equipment such as distillation columns, have been built of wood where feasible. Packed towers instead of bubble cap columns are used wherever possible to save scarce copper construction. Altogether, the technology is not a credit to modern engineering, but is a monument to ingenuity and ability to do without.

In this connection it is interesting that a recent reduction in the estimated industrial alcohol requirement makes it unnecessary at this time to approve the construction of any more new alcohol plants. This decision of WPB deferred approval of the alcohol projects at Carrollville, Wis., Dubuque and Keokuk, Iowa, and Moline and Peoria, Ill. As of the first of May, plans for these projects were nearly completed for presentation to WPB. Instead, it is now planned to have them available if later changes in the alcohol situation make new construction necessary.



Generalized flow sheet for producing alcohol from sulphite pulp waste liquor

GOVERNMENT BOOKKEEPING

In many cases it is almost impossible to determine the cost of producing alcohol. All ordinary rules of cost keeping have gone by the board. Getting production with the fewest man-hours, in the shortest time, and using the least critical materials has been the objective.

Consider, briefly, one procedure for getting the whiskey distillery into the alcohol business. This was done by contract with a RFC subsidiary, generally the Defense Supplies Corp. Through it the government contracted with the distillery management to be its operating agent in running a privately-owned plant.

Corn, the original grain used, was supplied from the reserves of Commodity Credit Corp., an agency of the Department of Agriculture. The distiller received his corn without charge. His obligation was to process it and produce the maximum yield of 190-proof alcohol. This he did for a fixed operating fee. He had an arrangement with the government whereby he disposed of the byproduct feed through commercial channels, insuring the maximum feed yields feasible. The dollar settlement between the distiller and the government, of course, took account of the money return from this feed.

Alcohol produced was shipped on orders of Defense Supplies Corp., usually to some smokeless powder plant or to some storage unit from which it was to be used for synthetic rubber manufacture. There was no billing of the alcohol. This was true, because the alcohol already owned by the government was simply being assigned to a different government agency.

Obviously, there was no possibility of answering the question, "What did it cost?" Several government departments and several commercial enterprises were all mixed up and no interplant or inter-agency money transactions were attempted. But the desired result was obtained. Alcohol was delivered for use where it was needed and at the time it was needed.

There have been numerous similar contract arrangements and in many cases the government has bought the alcohol outright from the producers. Prices have varied widely. In each case, however, the effort has been to give fair returns for service to commercial enterprise. And, fortunately, all the government agencies have sought to keep the running of the commercial plants in the hands of competent industrial firms. The effective results seem to have justified very fully this policy of government-industry cooperation and respect.

IMMEDIATE FUTURE

During the rest of the war period alcohol will remain one of the most important of our military chemicals. There is no evidence of an appreciable slackening in demand. More and more butadiene from alcohol will be desired and this fact is recognized even by those who a year or two ago would have preferred to have petroleum used as the raw material.

Now the petroleum refineries are occupied with the problems of making ever-increasing amounts of aviation gasoline and other petroleum war products. These demand much of the raw material and a large portion of the equipment which it once seemed back in 1941 would be available for butadiene manufacture. Furthermore, the chemical engineering staffs of the refinery companies are now busy with their wartime jobs of making high-octane fuel and other products which can come only from petroleum.

There still are and will continue to be large manufacturing operations in the petroleum industry for butadiene to be used in rubber synthesis. But there is no evidence that these will in any way crowd the alcohol-butadiene business to a less important position for the duration. In other words, alcohol from butadiene will be an extremely important factor so long as synthetic rubber plants are a government war responsibility. This is emphasized by the fact that probably 265 million gallons of alcohol will go into synthetic rubber during the fiscal year 1944 as compared to the almost insignificant 23 million gallons so consumed in the fiscal year 1943.

Smokeless powder programs have recently been materially curtailed from the earlier plans, and this has given the impression in some quarters that less alcohol will be needed in these explosives factories. In fact, this is actually the case and it is true that the increase in demand for alcohol for smokeless powder will be less than estimated a year ago. However, the powder plants will still lean heavily on the alcohol industry.

Alcohol will continue to be in demand for paint thinners, in chemical

Generalized flow sheet for producing alcohol from hydrolysed wood waste

synthesis, as a solvent, and for a multitude of other essential industrial uses. Every time some industry finds that it can get along with a little less alcohol, because of wartime curtailments, there are a dozen other new wartime demands to take its place. It is to be expected, therefore, that for the duration of hostilities there will be continuous demands from general industry quite the equal of those now experienced. It is now estimated that chemical manufacturers may obtain a total of about 80 million gallons of industrial alcohol for the coming year. Some 76 million gallons are estimated to have been so consumed in the fiscal year just ended.

There is, fortunately, one element of potential relief in sight which illustrates the interchangeability of chemical engineering processes. There is now a surplus capacity for ammonia synthesis, and this may permit the making of more methanol with present ammonia equipment. Thus methanol, recently very scarce, may become available in substantial quantities to help out on solvent and chemical demands which have lately been met only by ethyl alcohol.

POSTWAR ALCOHOL

When peace comes there will be a new problem of readjustment of alcohol allocation and distribution. Present forecasting in detail is futile, but a few general trends now visible are worth noting.

For some time after peace is declared we shall undoubtedly make synthetic rubber. This means that considerable alcohol may continue to be used for that purpose. However, the competition between alcohol and petroleum gases as raw materials for butadiene will then be greatly intensified and the relative cost of butadiene from the two sources will become an important factor.

Alcohol for smokeless powder manufacture will presumably not be an important problem. It may be desirable from the government point of view to maintain a certain standby capacity available for furnishing alcohol, just as we shall probably retain some explosives plants as military reserves for the nation. Yet there is one offsetting factor. The few alcohol plants which are government-owned are generally located so that they might provide for the use of grain to make alcohol for motor fuel. However, grain shortages are likely to continue into the postwar period and until world rehabilitation has been accomplished. To use the grain for foreign food relief may necessitate closing these alcohol plants, even though certain government officials might like to continue them under cooperative control.

Industrial demand for alcohol can be expected to slacken somewhat in war industries. But many industries that have been restricted by war rulings will resume normal activities and larger demands are certainly expected in postwar years than were reached at the peak of the prewar period.

Obviously, the alcohol of postwar years must compete more intensively with glycol and methanol as anti-freeze. In this use alcohol is at a definite disadvantage since its loss by evaporation is more than the loss of methanol for an equal anti-freeze capacity. In addition, the cost of alcohol is likely to be higher than that of methanol, and the complications of distributing it are considerably greater because of Internal Revenue rulings. Altogether, the future anti-freeze market does not appear to be a very promising one for the alcohol producer.

FUTURE PROCESSES

In the postwar years there will be plenty of structural materials for chemical equipment and more synthetic alcohol plants could then be built. It is a question, of course, of whether at that time a concern can justify new capital for such purposes when there may be a surplus of alcohol capacity which has been largely or wholly written off the books during war service. A close study of the opportunity for synthetic alcohol manufacture will be necessary to calculate the relative overall cost of synthetic vs. fermentation processes, since with cheap molasses and normal operating conditions the costs seem to be almost the same.

In the early postwar years there may be a shortage of grain but there probably will be plenty of molasses and plenty of ship space to move it to our Seaboard alcohol plants. This means that many of the industry's establishments in the Gulf States and near the Eastern Seaboard will again go to fermentation with molasses as raw material. At the present it looks unlikely that fermentation alcohol plants will be set up in Cuba or Puerto Rico.

Perhaps most certain of all forecasts is the fact that present industrial alcohol manufacture at whiskey distilleries will be generally stopped. Warehouse reserves of distilled beverages will be largely exhausted, and most distilleries who can get the capital will want to rebuild their stocks for aging as promptly as possible. Furthermore, these distilleries are high-cost alcohol makers and hence would be at a definite disadvantage in a competitive market. Everything indicates that they will promptly leave the alcohol business and again become beverage makers.

There has been much speculation as to whether sulphite waste liquor or sawdust processes may be established as new sources of cheap alcohol. However, such processes can hardly be expected to become an important part of the industry in the early postwar years for the one important economic reason that in order to enter the industry they would first require large new capital investment. Obviously, business with money is going to be cautious about going into such a competitive industry unless the new enterprise can demonstrate overall costs well below those for plants where the capital has been largely written off during the war. This factor is likely to delay large-scale applications of most new technologies regardless of their technical merits.

Overall results of war activities in the alcohol business will be an improved technology, lower costs, much lower market prices, and a magnitude of business not dreamed of in the peaceful years prior to 1939.

Reprints of this 8-page report are available at 25 cents per copy. Address the Editorial Department, *Chem. & Met.*, 330 W. 42nd St., New York, N. Y.

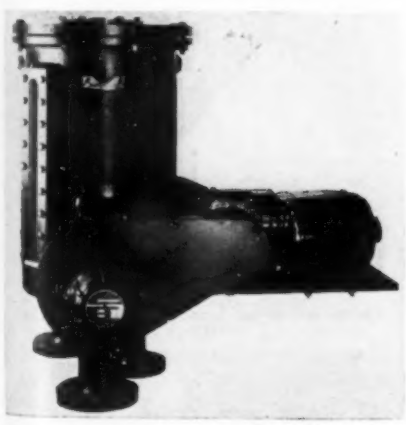
PROCESS EQUIPMENT NEWS

Improved Liquid Splitter

A RECENT ANNOUNCEMENT by Fischer & Porter Co., Hatboro, Pa., describes an improvement in the Rotaweir proportioning weir or liquid splitter, which was originally described on page 128 of our February, 1942, issue. This device can be used to split any liquid flow in the range up to 7,000 g.p.h., into any desired flow proportions. It consists of a vessel within which are two vertical cylindrical elements acting as rotary weirs. Each element consists of a stationary vertical tube containing a slot, within a similar slotted movable tube. Through a worm and gear arrangement the two outer tubes are connected together in such a way that when one tube is turned to decrease the slotted opening of one weir, the other turns oppositely to increase its opening. Thus a flow entering the vessel may be split between the two out-flow weirs in any proportion between zero for one, and 100 percent for the other, to the reversed proportions. Formerly operation was by hand. In the improved Rotaweir now announced, the weirs are driven electrically under control of a remote toggle switch. When the toggle switch is thrown to forward or reverse position the motor starts and changes the proportioning ratio until the switch is thrown to neutral position. A Selsyn motor at the Rotaweir transmits the weir position to a dial on a panel adjacent to the toggle switch so that the operator can see at all times exactly what percentage of flow proportioning he is securing. Such equipment, both in the former hand-operated model and in the new remotely controlled type, has been employed particularly for proportioning reflux to product during continuous distillation operations.

Another new development of this company is a line of small single and double rotameters equipped with built-in needle valves to permit close flow rate adjustment. The rotameter float indicates the flow and also acts as a check valve in the no-flow position. These meters are designed for measuring liquid flow up to 8 quarts per hour, and are intended primarily for controlling the flow of purge liquid used to keep open pressure taps to venturi and orifice meters when these are used in the measurement of slurries and suspensions.

New remote-controlled Rotaweir

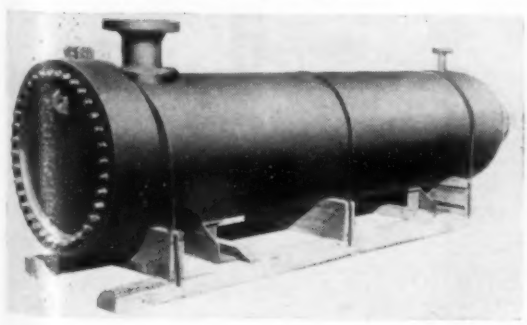


Pipeline Filter

FOR THE PROTECTION of valve seats, pumps and meters in pipelines handling petroleum products, against damage from solids produced by corrosion and carried by the flow, the American Locomotive Co., 30 Church St., New York, N. Y., has developed the Alco pipeline filter which is said to afford increased filtering capacity, decreased time for recharging of the filter, and greater ease of dismantling and assembly, as compared with conventional filters. As shown in the accompanying illustration, the filter consists of a cylindrical body having an inlet connection at the closed end and a removable head adjacent to the outlet connection at the opposite end. Within the body is a removable cylindrical filtering basket made of perforated metal. Concentric with the basket is a perforated efflux pipe. Packed between the perforated basket wall and the efflux pipe is the filtering material which may consist of wood shavings, excelsior, or other equivalent filtering medium.

Frequent recharging of a pipeline filter is, of course, necessary so that the design of the filter emphasizes minimum off-stream time. The open-end cover shown at the left is quickly removed by loosening the bolts and separating the two-part clamp ring. The basket may then be withdrawn from the shell, riding on non-ferrous guide strips, which avoids sparking danger. The basket is quickly disassembled for repacking, although a spare filter basket may be kept on hand, packed and ready for immediate use when the pressure drop indicates that a change of filtering medium is required.

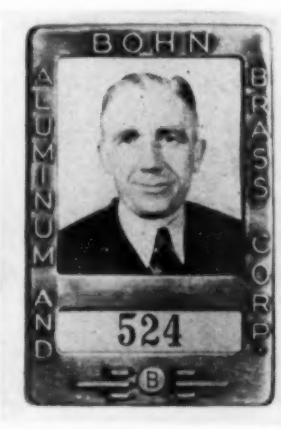
Improved filter for pipelines



Improved Employee Badge

PLANTS engaged in war production will be interested in a new badge for the identification of employees which has been made available by American Emblem Co., Utica, N. Y. Although the new barge is tamper-proof, it is re-usable, and so decreases the cost of operating an identification system. It also saves time by making possible quick changes of colored paper inserts when employees are shifted to different departments. Because of its re-usable features, it is pointed out that this badge helps to conserve the nation's supply of metal. The device is claimed to be tamper-proof since changes of photographs and color designations can be accomplished only with a special tool furnished by the manufacturer. The badge parts, photograph and color designations (if any) are locked by means of a metal rivet applied by a special tool. In sealing, the closing die engraves an identifying letter on the face of the rivet. In dismembering the unit, the opening die simply breaks through the rivet, destroys the seal, and renders the badge parts lose.

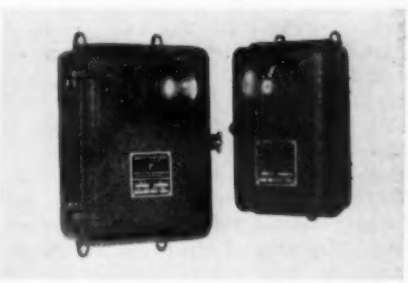
Re-usable tamper-proof badge



Long-Range Protection System

PHOTOELECTRIC PROTECTION over greater distances than formerly available is accomplished by a new photoelectric system announced by Photoswitch, Inc., 77

Long-range photoelectric light source and receiver



Broadway, Cambridge, Mass. In this system a beam of invisible light is projected over distances as great as 1,500 ft., and gives local or central-station alarm if an intruder enters the protected area. In operation the light source is aligned with a receiver on which it focuses a modulated beam of infra-red light. Because the receiver responds only to the frequency of light omitted from the light source, it is not affected by other artificial light, or by daylight. This permits extreme sensitivity, according to the manufacturer, enabling the equipment to function over a greater range than previously possible with photoelectric control, at the same time guaranteeing complete stability of operation. If invisible infra-red light is not required, the operating range of the system can be extended to more than 2,000 ft. Within the light source is a fan driven by a gearless, brushless motor which serves as a light chopper to produce the desired frequency of fluctuating light, and also cools the heavy-duty lamp. Once the beam of light projected to the receiver has been momentarily broken, the alarm circuit latches in operation. As an additional safety feature, either power or tube failure will cause the alarm circuit to operate as though the light beam had been broken.

Pneumatic Transmitter

TRANSMISSION of differential pressures for the measurement of flow and level is the function of a new force balance pneumatic pressure transmitter recently announced by Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill. This device converts a differential pressure such as is produced by the flow of a liquid through an orifice, or by the liquid level in a vessel, into an air pressure which varies proportionately with the differential pressure. It is claimed that the device has a transmitting accuracy within one-half of 1 percent of the meter range, and that its hysteresis loop is less than 1/20 of 1 per cent. A full-flow change is said to register within 15 seconds at a receiving instrument which is connected with the transmitter by 500 ft. of ¼-in. o.d. tubing.

Referring to the accompanying illustration, it will be noted that the transmitter operates on a balanced weigh-beam principle, with a diaphragm applying a force at either end of the beam. The beam *E* is attached to a yoke *D* and pivoted on bearings *A*. It is counterbalanced by a weight *B*. The beam enters a housing through a pressure-tight bellows seal *C*, and its lefthand end is connected by a link *K* to a differential pressure diaphragm *L*. The two pressures constituting the differential to be transmitted are applied to the two sides of this diaphragm.

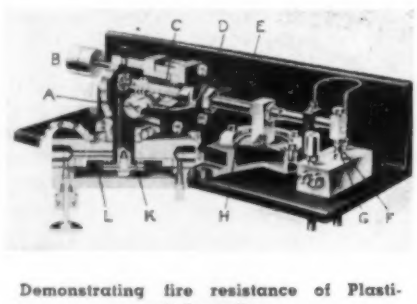
At the righthand end of the beam is a tip *F* covering a bleed nozzle *G* which is supplied with air through a constriction. Owing to the constriction the air pressure behind the nozzle will depend on the clearance of tip *F*. This pressure is applied to the counterbalancing diaphragm *H* which is attached to the beam. Thus the pressure under diaphragm *H* and behind the nozzle will be proportional to the differential applied to *L*, the proportionality depending on the lever arms of the beam. This pressure is then transmitted to the receiving instrument. The instrument can also be used to transmit a single pressure rather than a differential, if desired.

Fire-Resistant Roofing

A NEW LINE of steel roofing, siding, flashing and building accessories introduced by Coated Products Corp., Verona, Pa., is provided with a protective coating of Plastipitch, a material which it is claimed will not flame in event of fire, but will only melt locally at extremely high temperature. Materials protected with Plastipitch are said not to require the use of felts or membranes, and thus there can be no "fire wicking" action. Not only does the protection material resist fire, but it is also said to be resistant to acid and alkaline conditions and impervious to all ranges of climate.

The new process of applying Plastipitch is the result of several years of research utilizing a pitch of improved physical properties making possible the weatherproofing of many types of metals of various sizes, shapes, forms and gages. In application, a flat or preformed sheet or part is dipped into a tank containing the pitch material which is maintained at a temperature determined by the thickness of coating desired. The sheet or part is brought to the same temperature as the coating material to assure a perfect bond, after which it is withdrawn from the tank at a controlled rate to regulate the coating thickness and produce a sheet uniformly coated on both sides. After coating an anti-stick material is applied over the pitch coating to preserve the surface and prevent sticking of the sheets during transportation. Supplementary finishes, such as granule surfacings of various sizes or colors can be applied. Field forming or bending of metals so protected is said not to injure the coating.

Cutaway view of pneumatic pressure transmitter



Demonstrating fire resistance of Plastipitch roofing

Improved Crane Truck

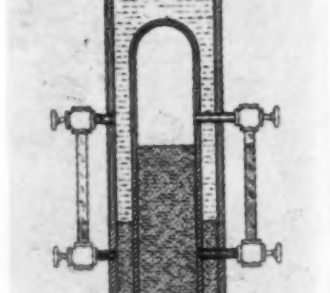
TWO TYPES of material handling are possible with the new Yale Model K23E-6C2T twin-unit crane, recently introduced by the Yale & Towne Mfg. Co., Philadelphia Div., Philadelphia, Pa. This truck combines in a single unit this company's 6,000-lb. capacity low elevating platform truck, with its 2,000-lb. capacity twin-unit crane. It is electrically powered, with four speeds forward and reverse, designed for maximum maneuverability in close quarters, plus greater visibility and safety for the operator. The crane unit combines the features of hoisting, booming and slewing, with the operations of the truck proper. Thus loads can be picked up, placed on the low elevating platform of the truck, into bins, on skids or spotted where desired.

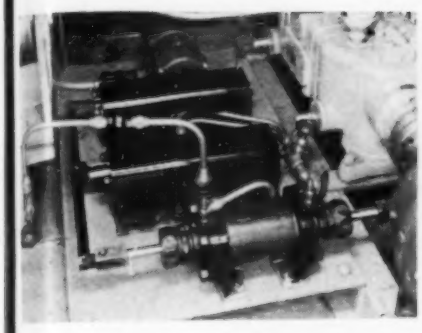
Liquid Hammer Equalizer

TO CUSHION SHOCKS and liquid hammer in pipelines, caused by reciprocating pumps or the sudden closing of valves, Wheatley Pump & Valve Manufacturers, Tulsa, Okla., has developed a pressure

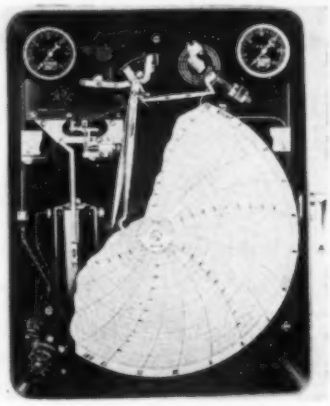
Combination crane and lift truck

Cross-section of low-pressure equalizer





Electro-hydraulic remote transmitter

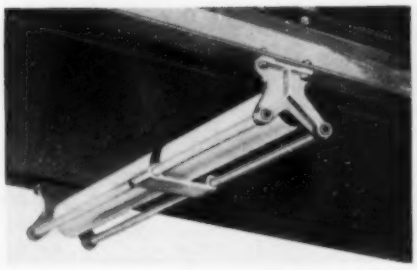


Automatic reset controller

qualizer or shock alleviator which is made in both high-pressure and low-pressure types. The high-pressure type, which is built for line sizes ranging from 4 to 8 in., is suited for pressure pulsations up to 850 lb. per sq.in. The low-pressure unit is built for line sizes of 4 to 10 in., and is ordinarily used for working pressures not over about 50 lb. The high-pressure type requires an initial charge of compressed air at a suitable pressure up to 500 lb. By giving the low-pressure type an initial compressed air charge it can be used at pressures in excess of 50 lb.

The usual method of absorbing pipeline shocks is to connect an air chamber to the line, with air in direct contact with the liquid being pumped. Frequently the air is absorbed gradually, entering the pipeline and acting as a corrosive agent. The new pressure equalizer avoids this difficulty by inserting a special sealing liquid between the air cushion and the liquid being pumped. This is accomplished by inverting the air chamber within a seal chamber of larger diameter, the lower portion of which is filled with the sealing liquid. For pipelines operated by the petroleum industry, the sealing liquid can consist of water inhibited with sodium dichromate, or a solution consisting of equal parts of water and ethylene glycol.

The low-pressure type, illustrated herewith, contains sufficient air at atmospheric pressure to cushion shocks at working pressures below 50 lb. In the high-pressure type, which is necessarily of greater height, it is necessary that air under some pressure up to 500 lb., depending on the working pressure, be supplied to the air chamber, to provide sufficient cushioning air. The low-pressure type, therefore, is not interfered with by shutdowns, but the high-pressure type must be closed off by a valve before shutting down the pumping system, or else must be recharged with air on starting again.



Self-aligning return roller

Effect on metal backing of new non-corrosive insulating cement (left), compared with ordinary insulating cement

Remote Transmitter

A REMOTE electro-hydraulic transmitter combining the company's jet-pipe principle with the unique functions of a Selsyn motor has been developed by the Askania Regulator Co., 1603 South Michigan Ave., Chicago, Ill. In this system the original impulse is transmitted from a sending Selsyn to a receiving Selsyn, the latter in turn positioning the jet pipe which moves practically without friction. The jet pipe then squirts a stream of oil under pressure against one or the other of two adjacent orifices communicating with the opposite ends of a hydraulic cylinder. By means of a follow-up linkage, the motion of the piston in the cylinder is communicated back to relocate the jet pipe, so that for every position of the receiving Selsyn, a definite position of the hydraulic piston is obtained for the purpose of operating heavy dampers or valves or other equipment requiring accurate remote operation.

New Recording Controllers

IMPROVEMENTS in its line of indicating and recording controllers of the pneumatically operated type have been announced by C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y. The new line includes on- and-off controllers, full-range throttling (proportional) controllers and throttling controllers with automatic reset. All are of the flapper-controlled type, employing a relay air valve, designed for interchangeability of control elements in the field to permit obtaining the type of control best suited to meet possible changes in process conditions. These instruments are obtainable for either pressure or temperature, the latter having either mercury-actuated, vapor-tension or gas-filled thermal systems. For the mercury-actuated type, this company's fully compensated system is employed, whereby temperature changes along the capillary are compensated by a parallel capillary system containing nitrogen gas, the pressure of which is applied to a compensating capsule and lever system which holds the pen at the true bulb temperature regardless of ambient changes along the capillary. With this compensation system, tube lengths up to 250 ft. are obtainable.

Self-Aligning Return Idler

TO AVOID the edge wear of conveyor belts resulting from the use of side-guide rollers, Stephens-Adamson Mfg. Co., Aurora, Ill., has introduced a new double-action self-aligning return roller which has the purpose of keeping the return run of a conveyor belt centered at all times. According to the manufacturer, one of these return rollers should be located near the tail pulley, with additional rollers spaced at 100-ft. intervals between standard return rollers. The new roller which turns on this company's Seal Master ball bearings, is pivoted at the center on an inclined axis. Thus, if the conveyor belt runs to one side, the greater weight and drag on that side of the pivot causes that end of the roller to slope downward and forward. The rotation of the roller is then at an angle to the travel of the belt and this angularity gently guides the belt back to the center. As the belt returns to center, the roller returns to its neutral position.

Improved Insulating Cement

ACCORDING to Baldwin-Hill Co., Trenton, N. J., the present necessity for applying insulating cements to unprotected metal surfaces, resulting from wartime inability to employ thick galvanized coatings, has been resulting in trouble from the moisture present in the ordinary cements, which not only tends to pit the metal, but to destroy the bond, thus causing the cement to peel and fall. On this account this company has now introduced its No. 1 non-corrosive insulating cement which contains a special rust inhibitor to prevent corrosive action, even when the cement is allowed to air-dry for a long period of time. This cement is based on the company's high-temperature resisting black rock wool which is effective up to 1,800 deg. F.

Equipment Briefs

EXPANSION in its line of boiler feed units has been announced by the Johnson Corp., Three Rivers, Mich. All sizes of this company's high-temperature

boiler feed systems are now available with either a standard-coupled type of pump, or a close-coupled type, as originally furnished. In addition, a new larger size of pumping unit has been developed, making the system available for use on boilers from 30 to 500 hp, operating at pressures up to 150 lb. The standard-coupled type of pump is now being offered for those installations where space is not at a premium, and where greater ease for servicing or testing of the motor is desired. It permits the use of a standard type motor, simplifying replacement if it should ever be necessary. The new pumping unit, like the original, employs this company's "pressure-equalizing" principle of operation, which consists in admitting the boiler pressure to an equalizing chamber behind the pump during operating cycles, leaving to the pump only the task of raising the returned condensate a few feet to the boiler water level.

TO ENCOURAGE workers to wear their goggles and keep them clean, Mine Safety Appliances Co., Pittsburgh, Pa., has developed a new goggle cleaning station, consisting of a wall-mounted container supplied with optical wiping tissues and an anti-fogging cleaning agent. It is only necessary to tap the goggle lens on an inverted vial of the cleaning agent, which then sprays on to the lens.

TAMPERING with fire extinguishers by meddlers or saboteurs is discouraged by the use of an inexpensive new extinguisher case, known as the Tampless Case, which is available from American-LaFrance-Foamite Corp., Elmira, N. Y. The extinguisher is sealed in a case of tough cardboard stock, which is opened by pulling on a seal string, thus breaking through a gummed paper sealing strip. By resealing the case can be reused. An important feature is that the case carries on its exterior precise information regarding the type of extinguisher which it encloses, and the classes of fire for which the extinguisher is suitable, together with complete operating instructions.

THE DEVELOPMENT of a new shear-hardness attachment for the Taber Abraser has been announced by the Taber Instrument Corp., North Tonawanda, N. Y. The new attachment is said to provide an accurate method of measuring the toughness qualities of surface finishes and their ability to resist digs, scrapes and similar abuse in actual service. The device operates by making a cut in a specimen of surface finish by means of an accurately weighted tool.

GENERAL DETROIT CORP., 2200 East Jefferson St., Detroit, Mich., has announced the development of a line of carbon-dioxide fire extinguishers to be sold under the name of "C-D/Fog" extinguishers. These extinguishers are available in both portable and installed types.

Asbestos-Cement Pressure Pipe

ETERNIT is the name given to a new line of extruded asbestos-cement pressure pipe which has recently been introduced by the Ruberoid Co., 500 Fifth Ave., New York, N. Y. The new pipe is claimed to be easier and more economical to install, and to have smooth walls which assure high carrying capacity by reducing friction to a minimum. The patented extrusion process used, according to the manufacturer, provides density and strength, insures uniform measurements and extremely smooth surface, without machining. The pipe can, when necessary, be cut in the field with a hacksaw and coupled immediately without machine preparation. Such pipe is, of course, immune to rust, tuberculation and galvanic corrosion. It is made in standard lengths up to 13 ft., and in diameters up to and including 6 in. For the present, it is available only in Eastern seaboard states.

Double Cone Blender

IMPROVEMENTS in double-cone blenders, for which a patent has just been issued, have been developed by H. K. Porter Co., Pittsburgh, Pa. The new blender incorporates a device within the cone which prevents any two particles of material from following the same path and simultaneously breaks up agglomerates. In batches run in 15 minutes, uniformity is stated not to vary more than 1 percent. According to the manufacturer, great difficulty has sometimes been encountered in the past in the use of double cone blenders in the mixing of certain dry powders, particularly where the amount of one powdered material is relatively large with respect to another mixed with it. It has been found that the grains of the material present in smaller proportion tend to agglomerate. The new improvement is said to overcome this situation and to permit processing of dry powders which are affected by dampness.

Quick-Disconnect Couplings

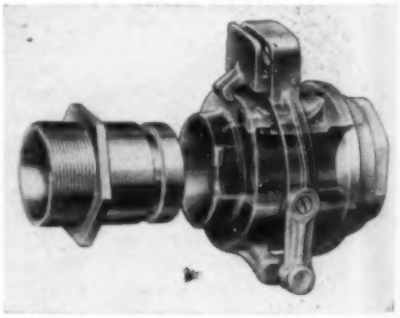
NEW APPLICATIONS and new designs of the Wiggins quick-disconnect couplings have been announced by the manufacturers, Wiggins Quick Disconnect Coupling Division, Wiggins Oil Tool Co., 3424 East Olympic Blvd., Los Angeles, Calif. These devices are said to be capable of handling all liquids and gases, as well as compressed air and vacuum. Because of their instantaneous release feature, much time is saved, permitting liquid moving jobs to be accomplished much more rapidly than by older methods. For example, in addition to their industrial uses they are used for fueling at sea where sudden squalls, fire hazards and other dangers make the ability to disconnect immediately of great value. The couplings come in sizes from ¾ to 10 in., and are disengaged by releasing a latch and throwing a lever. Connection is made by placing the two ends of the coupling together and raising the lever, entirely without the use of tools. The smaller sizes, from ¾ to 2 in., are die-cast, while larger sizes are machined from brass or aluminum. Single- and double-self-sealing models are available, as well as an open type. The operating principle is shown below.

Cutting new Eternit asbestos-cement pressure pipe

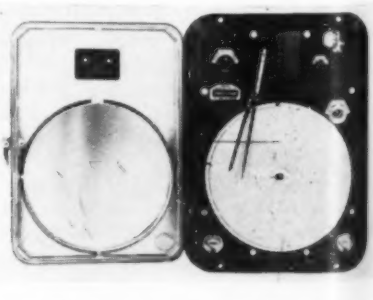
Convertible Controller

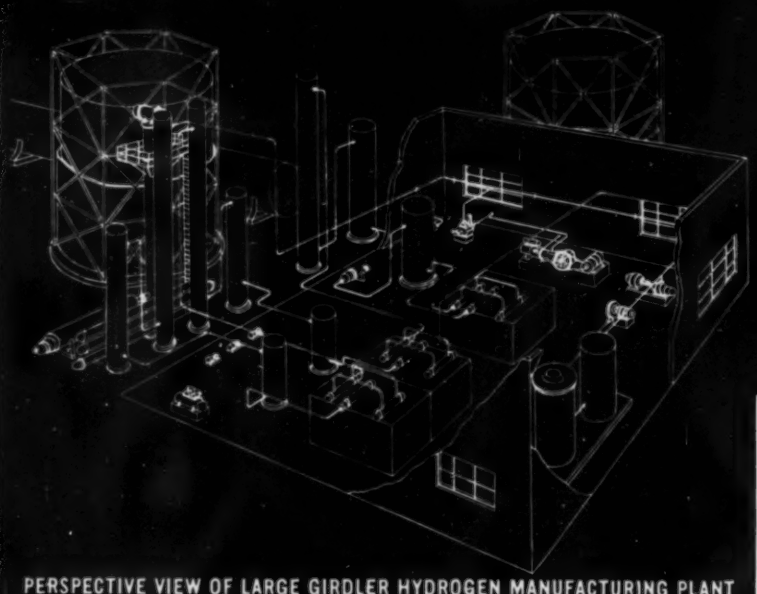
TO ENABLE USERS to convert readily from one type of control system to another, the Bristol Co., Waterbury, Conn., has introduced the new convertible Free-Vane controller, which is available in models for the control of temperature, flow, liquid level, pressure, draft, humidity, pH and time program. The convertible controller operates on the same basic "Free-Vane" principle used in previous models offered by the company but incorporates a number of design refinements which simplify the instrument and make it more convenient to service. Within the same case it is possible t install mechanisms for on-and-off contro proportional control, proportional contro with automatic reset, second-derivative control and second-derivative control with automatic reset.

Quick-disconnect coupling



Convertible Free-Vane controller

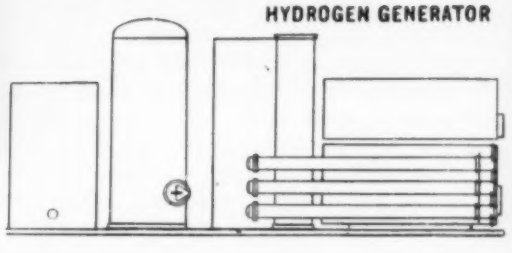




PERSPECTIVE VIEW OF LARGE GIRDLER HYDROGEN MANUFACTURING PLANT

LARGE OR SMALL

SIDE VIEW OF PORTABLE GIRDLER HYDROGEN GENERATOR



OTHER GIRDLER PROCESSES

Production, Purification, Separation, Reforming or Dehydration of

HYDROGEN SULFIDE
CARBON MONOXIDE
BLUE WATER GAS
ORGANIC SULFUR
CARBON DIOXIDE
HYDROCARBONS
HYDROGEN
NITROGEN
OXYGEN

and various mixtures.

WHETHER your hydrogen gas requirements are 500 cubic feet per hour or a million cu. ft. per hour, there is a Girdler Hydrogen Plant to meet your requirements.

These range in size from portable units which can be installed in trucks, trailers or boats to giant permanent plants.

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Girdler plants operate in a continuous manner and are economical and efficient even if operated at only 20% of the rated capacity.

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Salicylic Acid and Salicylate

SALICYLIC ACID is an old and well-known organic compound. Although used in direct form in certain types of pharmaceutical preparations and as a preservative for glues and leather goods, its major use is as an intermediate in the synthesis of dyes and other organic compounds. It is an important coupling component in the manufacture of the azo, stilbene, pyrazolone, triphenylmethane and aminoanthraquinone dyes. Certain of its salts and esters, the salicylates, are important pharmaceutical products. Acetyl salicylic acid is consumed in large quantity as the frequently used analgesic, aspirin.

Shown here are flowsheets and pictures of the manufacture of salicylic acid and methyl salicylate at the St. Louis plant of Monsanto Chemical Co., one of the largest producers of these materials.

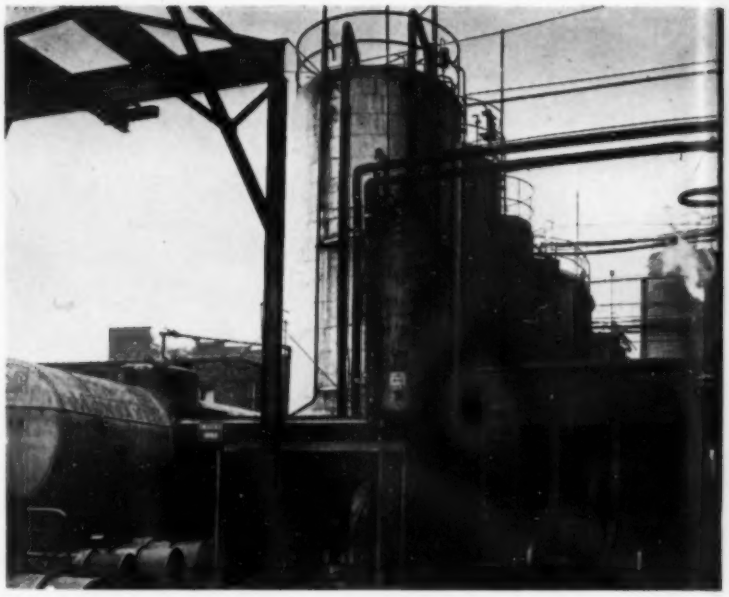
Phenol and caustic soda solution are received in tank cars and transferred to separate storage tanks. These materials are then withdrawn in predetermined quantities to mixers and a highly concentrated sodium phenolate solution prepared. The phenolate is desiccated, powdered finely and carbonated in autoclaves with carbon dioxide. Conversion to sodium salicylate is the next step, and after dissolving the charge in water it is blown or pumped into large wooden treatment tanks. After purification in these tanks the solutions are filtered and discharged by gravity into precipitation tanks. The slurry of precipitated salicylic acid then flows by gravity to continuous centrifugals where the technical salicylic acid is separated from the mother liquor, washed and discharged. The moist acid is dried in rotary dryers from whence it is delivered to other manufacturing departments for further processing.

In the manufacture of methyl salicylate the salicylic acid is dissolved in methyl alcohol, treated with a catalyst and esterified to methyl salicylate. The crude methyl salicylate is washed free of salicylic acid and then pumped to a storage tank. From there it is drawn by gravity into vacuum stills for distillation to a finished product. The material is discharged into tin lined steel drums or into carboys for final shipment.

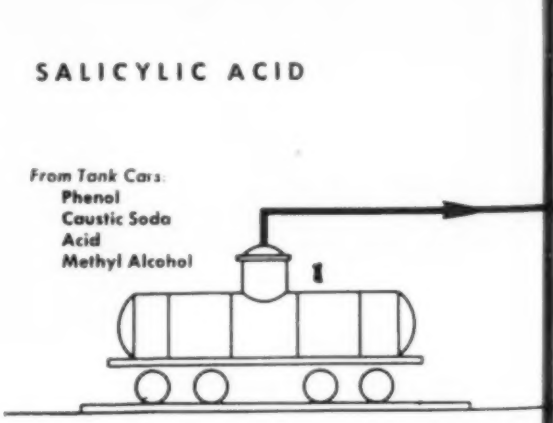
CHEMICAL & METALLURGICAL ENGINEERING

August, 1943

PAGES 132–135



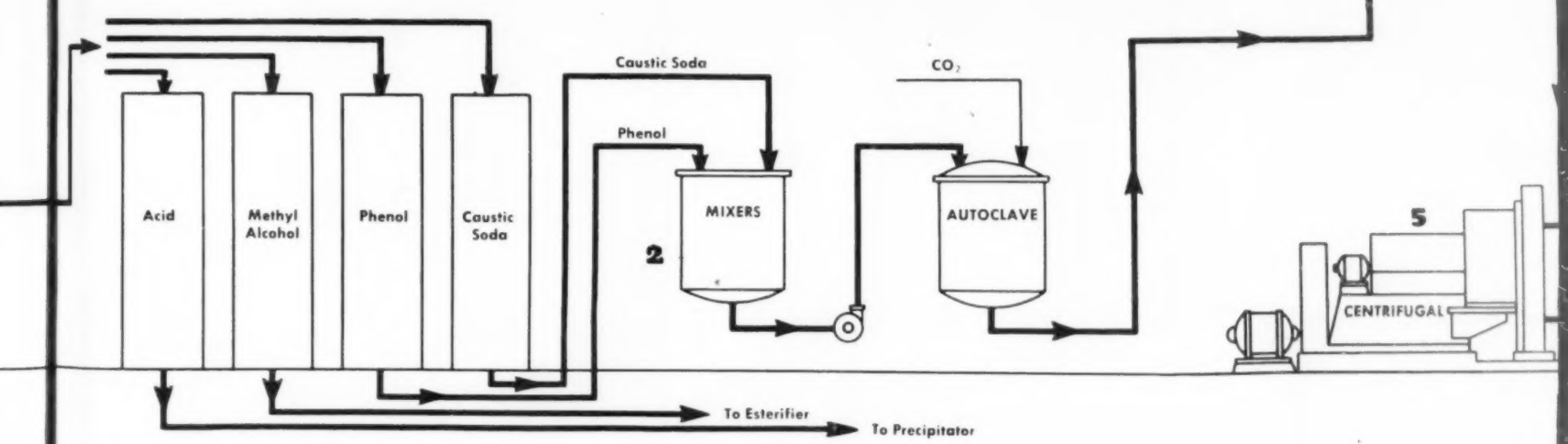
1 Raw materials are acid, phenol, methyl alcohol and caustic soda. They are stored in the tanks shown here



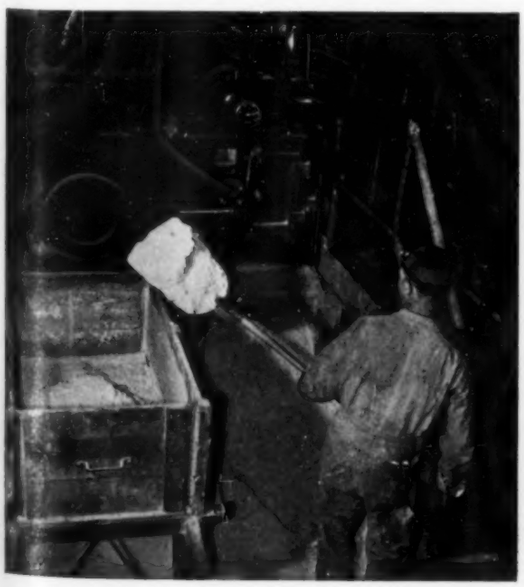
2 Phenol and caustic soda are withdrawn in predetermined quantities to mixers and a concentrated sodium phenolate prepared

3 Sodium salicylate is dissolved in water and blown or pumped into large wooden treatment tanks

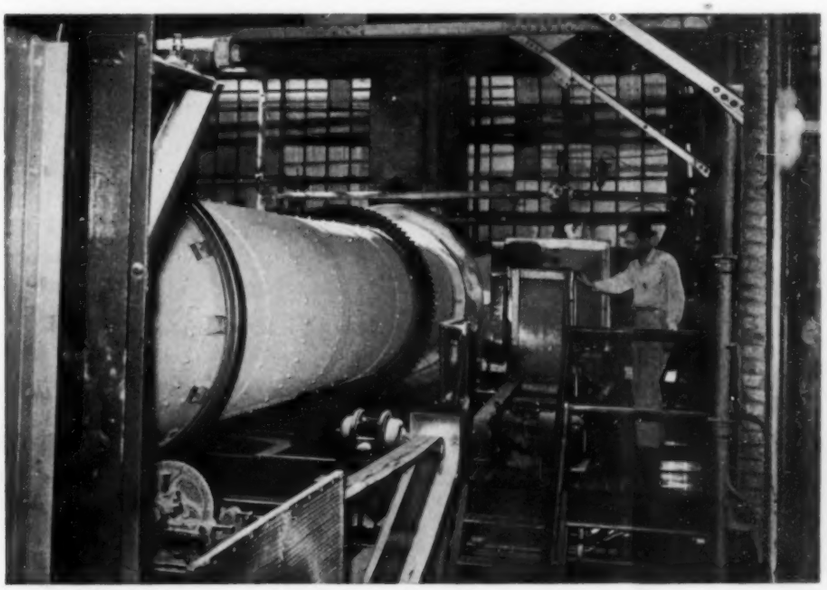
4 After purification in the wooden tanks the solutions are filtered and discharged by gravity into precipitation tanks



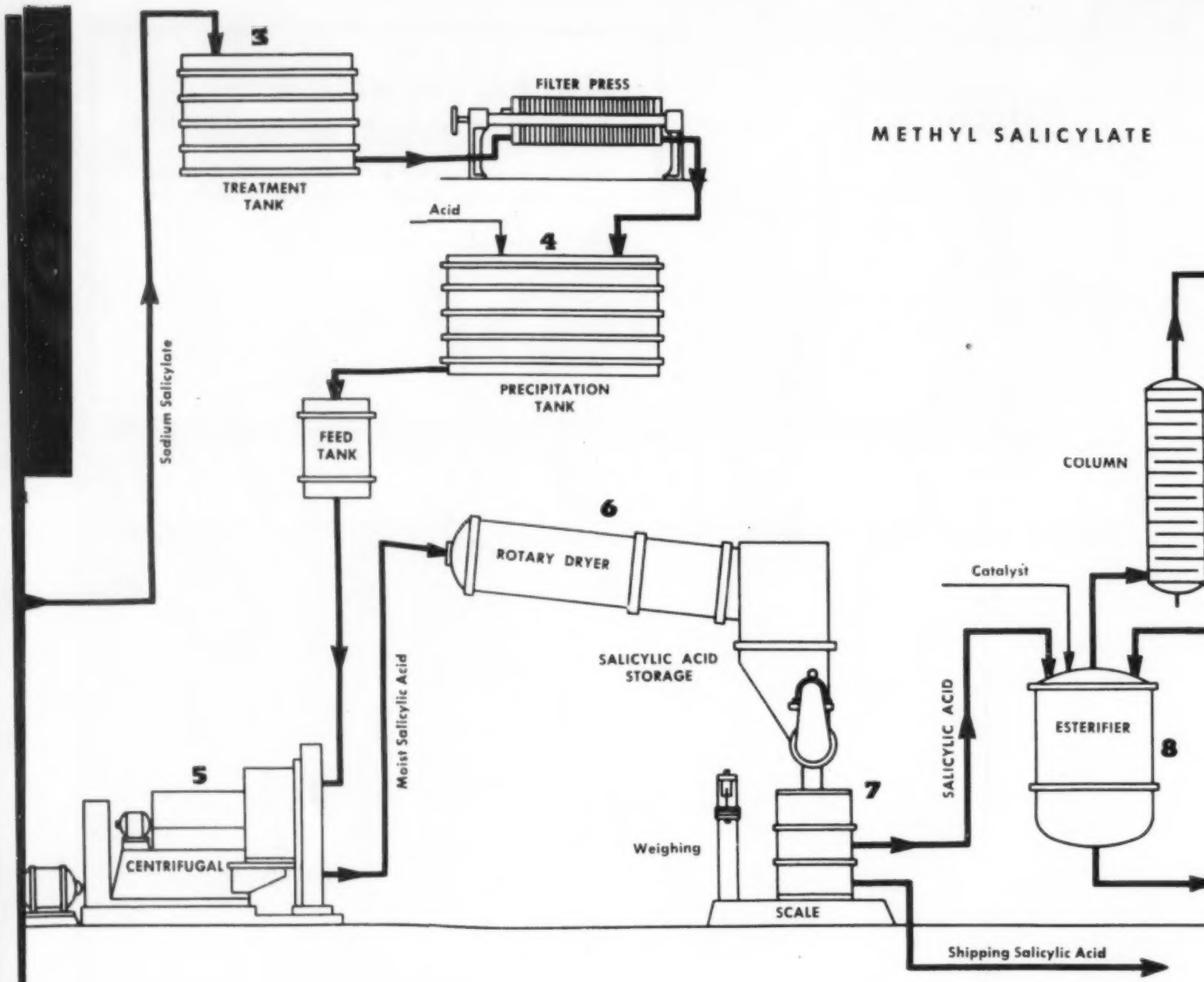
5 The slurry of precipitated salicylic acid then flows by gravity to continuous centrifugals



6 After the technical salicylic acid is separated from the mother liquor, washed and discharged from the centrifugal it is dried in rotary dryers



7 Dried salicylic ac
production departments



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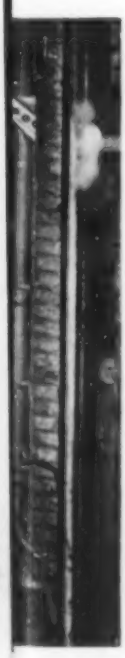
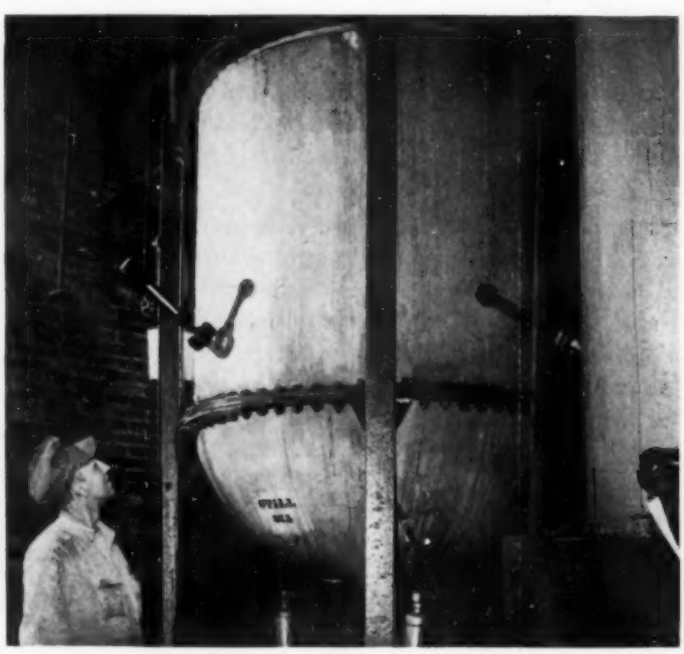
7 Dried salicylic acid is delivered to other production departments for further processing

8 For methyl salicyclate the acid is dissolved in alcohol treated with a catalyst and esterified

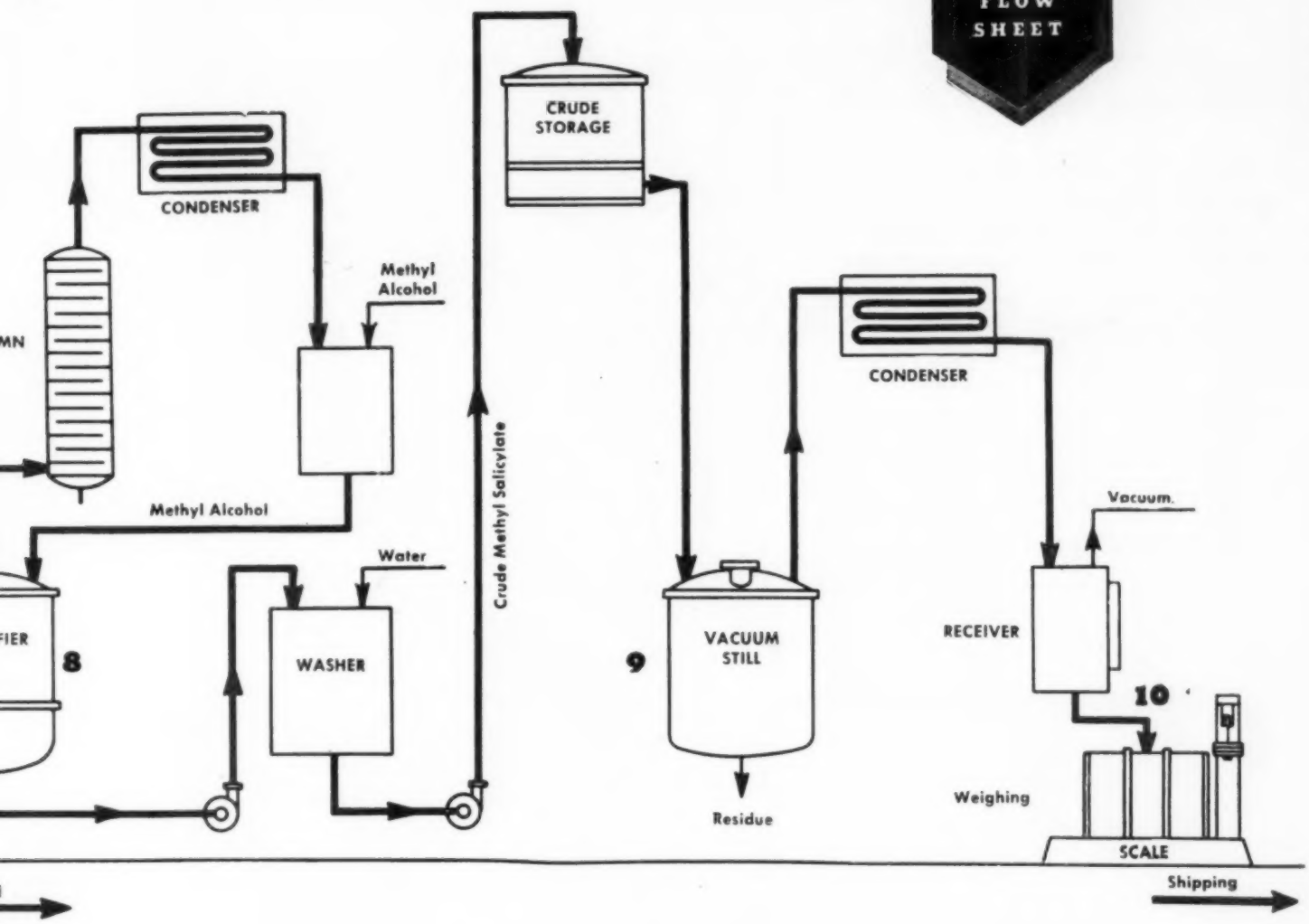
9
to





ATE

A Chem & Met FLOW SHEET



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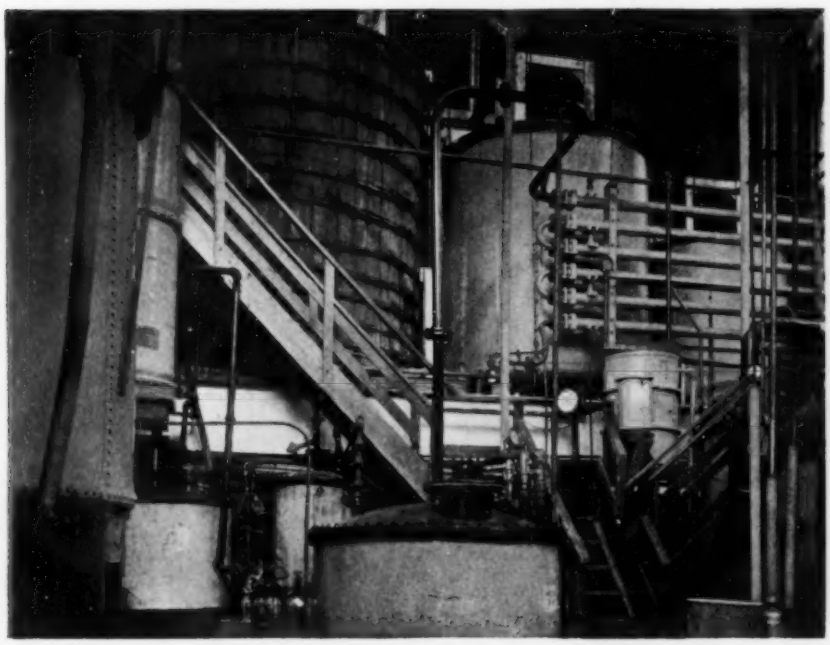
9 Crude methyl salicylate is washed free of salicylic acid and then pumped to storage. It is drawn by gravity into vacuum stills for distillation

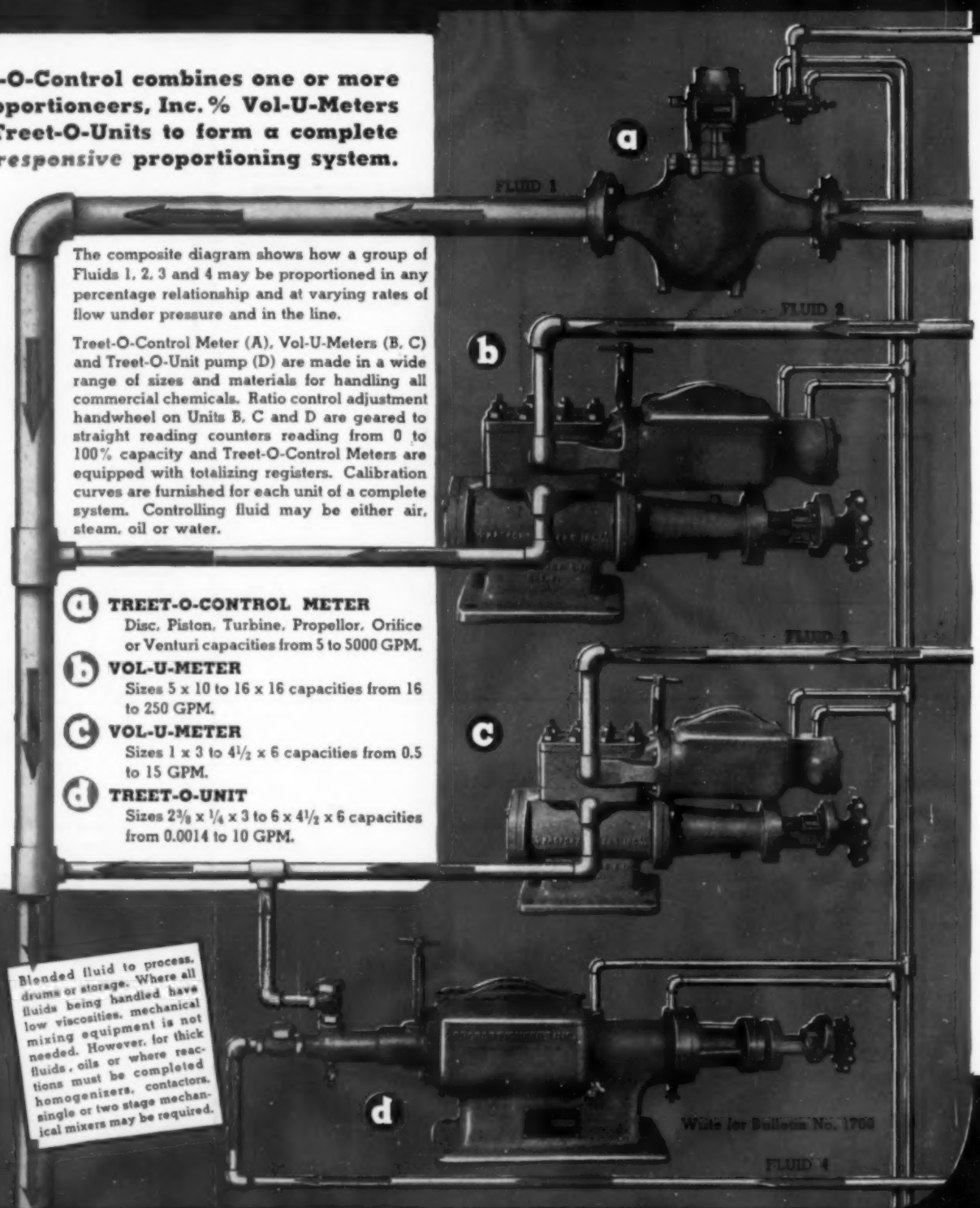


10 Finished product is discharged into tin-lined steel drums or into carboys for shipment

Treet-o-Control

••• SPEEDS PRODUCTION IN AMERICA'S PROCESS INDUSTRIES

Treet-O-Control combines one or more %Proportioneers, Inc.% Vol-U-Meters and Treet-O-Units to form a complete *flow responsive* proportioning system.



The composite diagram shows how a group of Fluids 1, 2, 3 and 4 may be proportioned in any percentage relationship and at varying rates of flow under pressure and in the line.

Treet-O-Control Meter (A), Vol-U-Meters (B, C) and Treet-O-Unit pump (D) are made in a wide range of sizes and materials for handling all commercial chemicals. Ratio control adjustment handwheel on Units B, C and D are geared to straight reading counters reading from 0 to 100% capacity and Treet-O-Control Meters are equipped with totalizing registers. Calibration curves are furnished for each unit of a complete system. Controlling fluid may be either air, steam, oil or water.

a TREET-O-CONTROL METER
Disc, Piston, Turbine, Propellor, Orifice or Venturi capacities from 5 to 5000 GPM.

b VOL-U-METER
Sizes 5 x 10 to 16 x 16 capacities from 16 to 250 GPM.

c VOL-U-METER
Sizes 1 x 3 to 4½ x 6 capacities from 0.5 to 15 GPM.

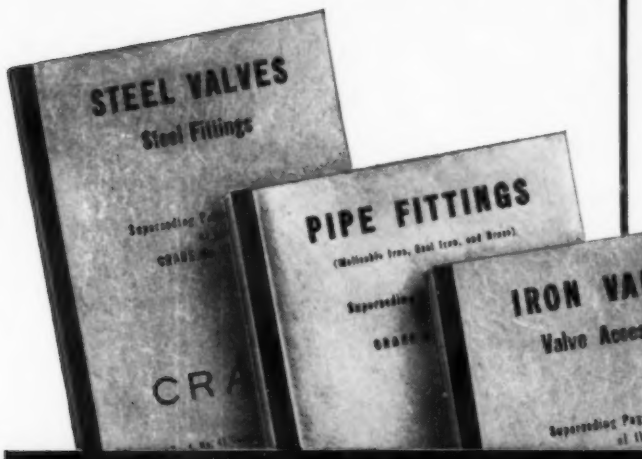
d TREET-O-UNIT
Sizes 2⅜ x ¼ x 3 to 6 x 4½ x 6 capacities from 0.0014 to 10 GPM.

Blended fluid to process, drums or storage. Where all fluids being handled have low viscosities, mechanical mixing equipment is not needed. However, for thick fluids, oils or where reactions must be completed homogenizers, contactors, single or two stage mechanical mixers may be required.

Write for Bulletin No. 1700

%PROPORTIONEERS, INC.%

29 CODDING ST., PROVIDENCE, R. I.



NEW WARTIME CATALOG SERVICE ON CRANE PIPING PRODUCTS . . .

Shows at a glance all items obtainable and those not being made under Simplification program of National Bureau of Standards. Saves time for piping maintenance men, specifiers, buyers.

WHAT'S BEING MADE AND WHAT ISN'T

IT'S basic home front strategy—simplification of lines. It is conserving vital materials and allowing greater production of most essential products. It enabled Crane, for example, to double and re-double the output of necessary valves and fittings for the Army, Navy, and war industries.

But to keep production lines flowing, piping men must know what equipment is being made and what isn't. Regular catalogs become quickly obsolete. So—to save time for maintenance men, specifiers and buyers, and make their jobs easier, Crane has introduced this novel cataloging service on piping products under the Simplification program.

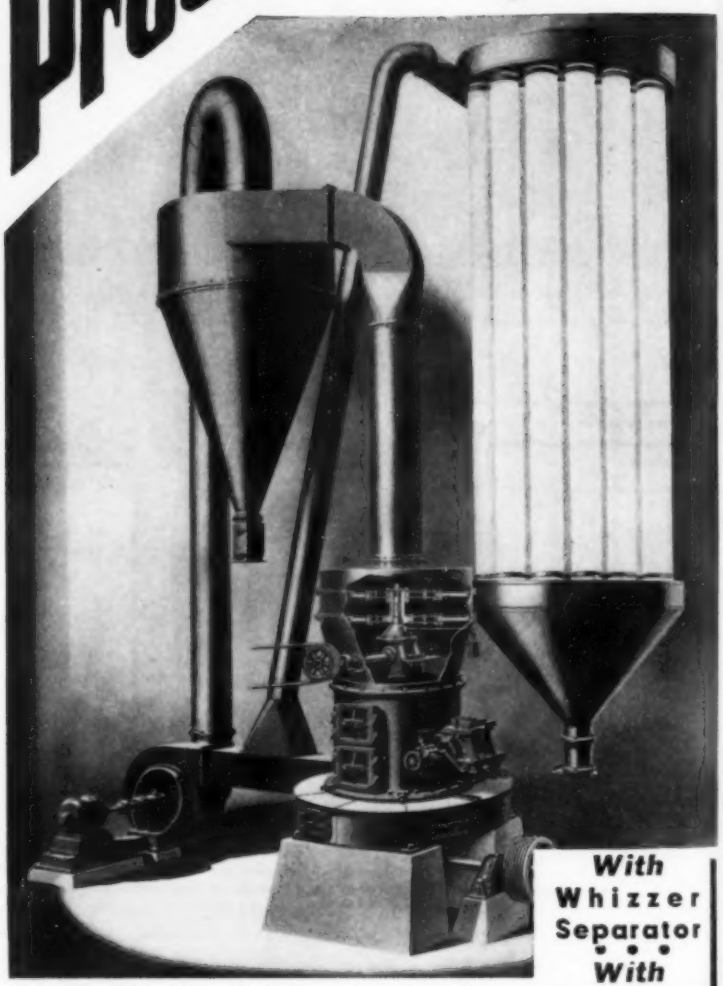
With an individual section for each class of product, innovation of this catalog service is that its pages are reproductions from the latest Crane general catalog, but with special markings instantly showing all products eliminated as well as those available. Noteworthy is that Crane still offers the broadest selection of valves and fittings for every service.

Most plants have these emergency catalogs. Under present operating conditions, their regular usage offers many important benefits. You can depend on them for the accurate specifications, application and ordering data necessary to keep pipe lines flowing for Victory. Crane Co., 836 S. Michigan Ave., Chicago, Ill.

ARMY E NAVY

CRANE VALVES

When BIG Production is needed!



With Whizzer Separator • • • With Drying System

High Side Roller Mill with double whizzer separator. Wide range fineness control by changing speed of revolving whizzer blades through variable speed transmission.

RAYMOND ROLLER MILL

for Capacities up to 40 Tons per hour

Write for CATALOG #51

SINCE 1887

With the chemical and process industries running at new high levels of production, Raymond Roller Mills are effectively solving today's pulverizing problems.

These modern machines are capable of delivering huge tonnages of finely ground materials at record low costs and with minimum use of manpower. They shorten operating time by handling the product automatically from feed hopper to finish bin in a continuous, dustless system . . . . drying, grinding, classifying, rejecting impurities and conveying the material to storage.

They provide close product control, enabling you to meet exacting specifications, as to dryness and fineness in producing chemicals, pigments, fillers, resins, fullers earth, iron oxides, talc, barytes, and many other non-metallic minerals.

Available in Super Mills and Midget Roller Mills for large and small plant requirements.

RAYMOND PULVERIZER DIVISION
COMBUSTION ENGINEERING COMPANY, INC.
1311 North Branch Street CHICAGO
In Canada: Combustion Engineering Corporation, Ltd., Montreal

SINCE 1887

Chemical Engineering NEWS

PROTEIN RECOVERY NECESSARY TO MEET FEED DEMANDS

One of the most serious food problems confronting official Washington is the supply of animal feed to ensure future meat supply for human food. Many chemical process industries are being urged to help by arranging for more complete protein recovery from what are now wastes, like the thin slops of industrial alcohol plants. Any other enterprise which can make effective recovery of protein feeding stuffs from wastes of chemical processing will be helped to do this wherever practical. Even though such recovery is not apparently profitable in a money sense there may be suitable aids and priorities afforded because of the extreme shortage of feed in prospect.

Supplemental production of protein materials is also being attempted. One important proposal is that dry yeasts be manufactured from fermentable wastes. Where such wastes are not suitable for alcohol plant raw material they may be made into fermentation mediums for yeast growing. Cane molasses that is wasted in Cuba and Puerto Rico is also being considered for such use. Certain yeasts grown on such medium with addition of ammonium salts convert the sugars and the ammonia into high protein yeast, often with high vitamin content also. The resulting yeast can be dried for transport and industrial delivery to points where there is need is feasible even though the fermentable raw material or surplus molasses can not be moved because of its low grade or because of shortage of tankers for transport.

More complete recovery of the protein wastes at alcohol plants is being planned. If the recently developed Balls-Tucker process proves a success, there may be large recovery of gluten at early stages of processing where granular wheat flour is the raw material. Commercial-scale trials of the process and aggressive development work are in progress. All this activity gives some promise of helping supply feed which is no longer adequate in view of the huge demand for corn.

GENERAL ANILINE ELECTS NEW PRESIDENT AND DIRECTORS

Last month the General Aniline and Film Co., 97 percent of whose stock has been vested by Alien Property Custodian Leo T. Crowley, selected a new board of directors. The present board comprises Neal Dow Becker, president of the Intertype Corp.; George W. Burpee, executive vice-president, American Export Airlines; Colvin Brown, general manager, Quigley Publishing Co.; William F. Carey, Commissioner of Sanitation, New York; Robert F. Carr, president, Dearborn Chemical Co.; William H. Coverdale, Coverdale & Colpitts, engineers; H. R. Gallagher, former president, Consolidated Oil Co.; John D. Hertz, Lehman Brothers; Matthew J. Hickey, Jr., vice-president General Dyestuffs Corp.; W. F. Humphrey, president, Tide Water Associated Oil Co.; Col. Louis Johnson, president, General Dyestuffs Corp.; Thomas O'Hara, president, Colonial Ice Co.; Dr. E. C. Williams, vice-president, General Aniline & Film Corp.; A. N. Williams, president, Western Union Telegraph Co.; Dr. R. E. Wilson, president, Pan American Petroleum & Transport Co.

The directors elected George W. Burpee as president to succeed Robert E. McConnell, resigned.

EXPORT ALLOCATIONS OF POTASH UNDER CRITICISM

Some well-informed observers are quite critical of potash allocations. They object specifically to the assignment of 72,000 tons of 60 percent grade potassium chloride to British farm use through lend-lease channels. Critics agree that this potash should go where it will raise the most food in support of the war effort. But they believe the resulting shortage of potash for U. S. fertilizer will do more harm in cutting food production than the British use will do good. This is partly based on the understanding that much of the British increase in use of potash will be on land where it is doubtful as to the crop increasing because it is newly worked land.

The British naturally sought as much potash through lend-lease channels as possible. Alternate sources were Spain, Palestine, and Russia. But procurement there meant immediate cash payment, and some difficult negotiations. It is still hoped that those sources can supply more potash and make unnecessary the shipment of the total allocated tonnage from this country. To achieve that result will apparently require a new review of this assignment by competent fertilizer experts of the Department of Agriculture and of industry. They may be able to show that more benefit to the total food supply of the United Nations can come from keeping a bit of this potash in the United States.

METALLURGISTS WILL LECTURE IN BRAZIL

Advanced practices in the application of metallurgy in the United States will be communicated to Brazilian scientists and industrialists during the coming year through a technical educational project established at the Escola Politecnia of the University of Sao Paulo, one of the leading engineering schools of Brazil.

The project is being jointly financed through the office of Nelson A. Rockefeller, coordinator of Inter-American Affairs and the Escola Politecnia. It is administered by Stevens Institute of Technology under a contract with the coordinator's office.

Four outstanding United States metallurgists have been appointed to give lectures on fundamental metallurgy, each to remain in residence there for three months. The first lecturer, Dr. A. Allan Bates, manager of the chemical and metallurgical department of Westinghouse Electric and Mfg. Co. research laboratories, reached Brazil late in July and already has taken up his duties. He will be followed by Dr. Robert F. Mehl, head of the department of metallurgical engineering and director of the metals research laboratory of Carnegie Institute of Technology. Prof. Arthur Phillips of the Hammond Metallurgical Laboratory, Yale University, and Prof. Gregory J. Comstock, director of the powder metallurgy laboratory at Stevens Institute round out the list.

ENEMY-OWNED PATENTS MADE MORE ACCESSIBLE

A more liberal policy in granting licenses under patents seized from enemy owners was announced last month by Alien Property Custodian Leo T. Crowley. Effective Aug. 1, the fee for obtaining a license to use enemy-owned patents held by the Custodian will be a flat $15 for each patent. Hitherto, licenses have been issued for a fee of $50 for a single patent plus $5 for each related patent included in the same license.

Information concerning the 40,000 patents and patent applications now held by the Alien Property Custodian can be obtained by addressing the Office of Alien Property Custodian, Field Bldg., Chicago. Except for those patents which already were exclusively licensed to American industry prior to seizure, patents which formerly belonged to enemy nationals are now available under license on a non-exclusive, royalty-free basis for the life of the patents.

LARGE APPROPRIATION FOR BUREAU OF MINES

Congress gave the Bureau of Mines some real money to spend for research and development projects during the coming fiscal year. Appropriation for the Department of the Interior included a total of $16,170,875, over $11,000,000 of which is new money for national defense projects. Detailed plans of the Bureau were not entirely complete but include an expenditure of $900,000 for the continuation of pilot plant operations for the beneficiation of domestic manganese ores and to demonstrate the commercial feasibility of producing metal therefrom by the electrolytic and other processes.

An allocation of $490,000 will provide funds for studying the applicability of various processes other than the Bayer process for the production of alumina from domestic low-grade siliceous bauxites, clays, and alunites and to conduct pilot-plant tests to demonstrate the commercial application of processes that make possible the utilization of low-grade domestic raw materials for the production of alumina. A further allocation of $1,860,000 provides for the investigation and evaluation of potential domestic sources of aluminum. These investigations include laboratory research concerning the extent, mode of occurrence and quality of the ores.

Investigation and development of methods for the recovery of magnesium from domestic raw materials will be financed by an allotment of $225,000.

TRADE ASSOCIATION UNIT IN COMMERCE DEPARTMENT

Creation of a Trade Association Unit in the Bureau of Foreign and Domestic Commerce was reported last month. This action which consolidates existing functions of the Bureau in the trade association field to give broader scope to the work and simplify administration will not require additional expenditures or personnel.

There are approximately 2,000 trade associations of national or regional scope active in domestic and foreign trade of the United States and 7,000 State and local associations, a large number of which are in regular contact with the Commerce Department.

C. J. Judkins who has been in immediate charge of trade association work for the Commerce Department for more than 10 years has been named chief of the unit. He has devoted many years to the business cooperative movement as a practicing attorney in trade association law and as a staff member of the Chamber of Commerce of the United States and other business organizations.

FOOD ENRICHMENT POLICY FIXED BY F.&D.A.

Enrichment of foods with vitamins and minerals is now so generally practiced as to require a statement of guiding principles. Such a statement of policy was promulgated formally by F.S.A. in order to indicate how observance of the Food and Drug law would be regulated in these regards. The most important part of the principles stated was:

"The labeling or advertising of a food as enriched with vitamins and minerals is an implied promise to consumers that it contains, in addition to the normal constituents of the unenriched food, sufficient vitamins and minerals to make a substantial contribution to the nutritional welfare of persons eating the enriched food in customary amounts. In order to promote honesty and fair dealing by fulfilling this implied promise, it is necessary that the kinds and quantities of enriching ingredients be determined in the light of deficiencies of the various nutritional factors in the diets of the population in general and of significant population groups, the place occupied by the food in such diets, and the suitability and effectiveness of the food as a carrier of the enriching ingredients without undue separation or loss before consumption."

CABOT BUILDS BATTERY CARBON PLANT IN TEXAS

Godfrey L. Cabot, Inc., Boston, has completed a million pound dry cell carbon plant at Pampa, Texas, for the manufacture of battery carbon. This carbon was developed by the research department of the Cabot company working in conjunction with dry cell manufacturers throughout the United States, and with the Fort Monmouth Signal Laboratory of the United States Army Signal Corps.

An application has been filed with the War Production Board for permission to build a second plant of two million pounds additional capacity at the earliest possible moment. American dry battery manufacturers have heretofore been dependent on sources of supply outside the United States.

METAL CONGRESS SCHEDULED FOR CHICAGO IN OCTOBER

Plans for the 25th annual National Metal Congress in Chicago the week of October 18, have been announced by W. H. Eisenman, managing director of the meeting and national secretary of the American Society for Metals.

Four national societies will again cooperate in the Congress. In addition to the American Society for Metals, there will be the American Welding Society, the Wire Association and the Iron and Steel and Metals divisions of the American Institute of Mining and Metallurgical Engineers.

DIAMOND ALKALI TAKES OVER GEORGE CHEMICAL CO.

Effective August first, the Diamond Alkali Sales Corp., took over the operation of The George Chemical Co., Inc., with C. V. Douglas as New York District manager. New headquarters have been established at 570 Lexington Ave. Messrs. J. M. Williams, H. B. Clark, F. C. Whitrock, and H. H. Harben formerly with The George Chemical Co. and C. L. Flaccus, Jr., will be associated with Mr. Douglas.

FOR PRODUCTION EXCELLENCE

Among the companies which, in the past month, have been awarded the honorary Navy "E" and joint Army and Navy "E" burgee for exceeding all production expectations in view of the facilities at their command, are included the chemical and explosives plants, the chemical process industries and the chemical engineering equipment concerns listed below. Other process and equipment plants will be mentioned in these columns as the awards are presented to the individual plants.

Ark-less Switch Corp., Watertown, Mass.
Atlas Powder Co., Reynolds, Pa.
Baker Mfg. Co., Springfield, Ill.
The Bastian-Blessing Co., Chicago.
Bectin, Dickinson & Co., Rutherford, N. J.
Borg-Warner Corp., Muskegon Heights, Mich.
The Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia.
E. Burkhardt & Sons Steel & Iron Works Co., Denver, Colo.
Cannon Electric Development Co., Los Angeles.
The Carborundum Co., Niagara Falls, N. Y.
Casey-Jones, Inc., Luray, Va., Elkton, Va., Mount Jackson, Va., Shenandoah, Va., and Woodstock, Va.
L. D. Caulk Co., Milford, Del.
Chicago Bridge & Iron Co., Newburgh, N. Y.
E. D. Clapp Mfg. Co., Auburn, N. Y.
Conmar Products Corp., Newark, N. J.
C. G. Conn, Ltd., Elkhart, Ind.
Corning Glass Works, Charleroi, Pa.
Difco Laboratories, Inc., Detroit.
The Dow Chemical Co., Pittsburg, Calif.
Ethyl Corp., Baton Rouge, La., and Wilmington, Del.
Fay & Scott, Dexter, Me.
Freeport Sulphur Co., Port Sulphur, La., and Freeport, Tex.
General Electric Co., York, Pa.
General Machinery Co., Spokane, Wash.
Gillette Safety Razor Co., Boston.
Hannifin Mfg. Co., Chicago
Hercules Powder Co., Hercules, Calif.
H.R.L. Machine Works, Inc., Seattle, Wash.
Industrial Metal Fabricators, Inc., Chicago.
International Silver Co., Meriden, Conn.
Johns-Manville Products Co., Lompoc, Calif.
Cyril Johnson Woolen Co., Stafford Springs, Conn.
Librascope, Inc., Burbank, Calif.
Magee Carpet Co., Bloomsburg, Pa.
Metro Tool and Gage Co., Chicago.
Monsanto Chemical Co., Springfield, Mass.
Multiplex Mfg. Co., Berwick, Pa.
Philip Myers Co., Towson, Md.
Nashville Bridge Co., Nashville, Tenn.
The National Carbon Co., Niagara Falls, N. Y.
Pacific Gear & Tool Works, San Francisco.
Phoenix Tool & Mfg. Co., Chicago.
Piedmont Cotton Mills, Egan, Ga.
Seegull Mfg. Co., Philadelphia.
Sloan Valve Co., Chicago.
Springfield Buick Co., Springfield, Mass.
Taylor Instrument Co., Rochester, N. Y.
Waukesha Foundry Co., Waukesha and Watertown, Wis.
The Wiremold Co., West Hartford, Conn.
Worthington Mower Co., Stroudsburg, Pa.
L. A. Young Spring & Wire Corp., Trenton, N. J.
Zollner Machine Works, Fort Wayne, Ind.

WASHINGTON NEWS

CONGRESS came in like a lamb and went home like a lion. After kicking some of the Administration's pet projects in the teeth the law makers adjourned to see what the constituents actually think about things. Their return in September according to some of Washington's most astute political observers will see a more subdued group. Republicans will be more cautious. They will fear giving political ammunition to the Democrats. The conservative Democrats who joined with the Republicans to defeat certain administrative measures will move closer to their regular party affiliates as the general election approaches.

But other political commentators think that Congress may return from the recess in a more belligerent state than when it left. There is an historical background for their contention. They say that when the House gets up on its hind legs and paws the air, as it did during the closing weeks, it may be more nearly reflecting public opinion than the senior chamber which always moves more slowly and conservatively. If the attitude of the House is the public attitude, the Senate will return to Washington in September in an equally rampant mood as it has always done in the past under similar circumstances.

The Washington correspondent of *Business Week* does not think that Congress will necessarily return in a docile mood but believes that "the recess will act as a cooling off period. Instead of headlong revolt, there is likely to be an orderly opposition. This opens the way for an informal peace offer from the Administration and gives the President a chance to do some home front horse-trading."

One of the few certainties in the political picture is the Administration's coming struggle to untangle the mess on the domestic front. Probabilities are that the 1944 elections will be fought on the arguments of military and international diplomatic successes versus home front failures. Success in solving home front problems may cut the ground from under the Republicans. Failure will bring a White House attempt to pass the buck to Congress.

Government Competition

Far-sighted members of the chemical industry have raised the question about the possible competition between products of privately financed plants and products of government-financed plants sold below cost by means of a government subsidy. An example which has received some recent attention, according to reports from the field, is to be found in the competition expected between synthetic rubber and vinyl resins.

Since there is now an insufficient supply of both products, there seems to be no prospect of difficulty prior to late 1944 when the production of synthetic rubber is expected to approach its peak. Nevertheless the industry would like to know where it stands so that plans for the future can be made with a certain degree of assurance. The whole chemical industry should watch developments of pricing and purchasing policies in this field since they may be the shadows cast ahead by coming events.

Spokesmen for the vinyl resin producers have raised some interesting questions such as the allocation policies on raw materials. Will the government-owned and operated plants be given preferred treatment? Will the allocation of business by the armed services and other government purchasing agents be away from the use of vinyl resins and toward the use of synthetic rubber? If synthetic rubber is to be favored in government purchases will the restrictions on the use of resins for items now denied be lifted, assuming that raw materials are available?

OPA's price schedule has a subsidy of 17½ cents per pound of contained synthetic rubber that is paid direct to Rubber Reserve by the Army and Navy on purchases by those organizations. Rubber Reserve takes a loss of 17½ cents per pound only on synthetic rubber sold for civilian uses. Vinyl resin producers can compete on price with synthetic rubber sans subsidy.

Postwar Adjustment

Problems of postwar adjustment have now been more clearly pictured than they were by Secretary of Commerce Jesse Jones in a radio address made on July 21. Speaking about government-owned manufacturing plants, he said, "The wisdom with which we consider and determine the future utilization of these government-owned plants will have a great influence on our economic future." The Defense Plant Corp. alone has approximately $9,000,000,000 of government money invested in plants and equipment. The Reconstruction Finance Corp. has built and financed more than 1,500 plants with the result that Uncle Sam is in a position to stifle private enterprise. Actual figures given by Mr. Jones bear out his statement.

Estimating that a government expenditure of probably $25,000,000,000 has been made during the past three years for the construction of plants and facilities of various kinds, Mr. Jones went on to explain in greater detail the stake of the government in many of the basic industries. The annual capacity of government-owned plants for the production of aluminum is 1,200,000,000 pounds—more than the capacity of all privately-owned aluminum plants. The government also has built and owns 45 plants for the fabrication of aluminum.

"Private industry will own only about 8 percent of the total magnesium production of the country." The government has invested over $400,000,000 in facilities for producing magnesium.

Ten percent of the country's total steel-making capacity will be government-owned at the end of the war. This "will be enough seriously to affect the industry because the steel industry of the entire country has operated over a period of 20 to 25 years at only 60 percent of capacity. Therefore, the government plants operating at full capacity would absorb approximately 20 percent of the total requirements for steel."

In the case of synthetic rubber the government will own the entire industry. "It is not reasonable to suppose that we will rely entirely upon synthetic rubber after the war, but we will need to maintain and operate the most efficient of these plants and produce a very substantial amount of our rubber requirements, so that never again will we be wholly dependent on outside sources for rubber."

At the end of the war the government will own almost one-half of the country's machine tool manufacturing facilities. In the aviation industry the government's investment is 10 times the value of privately-owned investments. Of 50 plants for the manufacture of high octane gasoline that have been government financed, 20 are owned by the Reconstruction Finance Corporation. In the field of transportation, the government will own by the end of the war 3,800 miles of pipe lines.

Considering the adjustments that confront the country because of the enormous government investment in manufacturing establishments, Mr. Jones went on, ". . . I have no fear but that government will deal fairly with industry, because I believe that the people of our country want to maintain the principle of private initiative and private enterprise, which is the foundation upon which our country and its freedom has been built.

"There will, of course, be differing opinions. No doubt some will advocate that government stay in business and operate the facilities with federal funds. Others may urge that we scrap a large part of this war expansion in order to remove undue competition. Still others will be looking for bargains, hoping to buy from the government at sacrifice prices.

"We should, of course, be on guard against undue pressure from any of these groups, for if there ever was a question which must be settled in the national interest, it is the future utilization of this vast new industrial empire."

Patent System Changes

Important recommendations for bettering the patent system have been made by the National Patent Planning Commission under the chairmanship of Dr. Charles F. Kettering. As submitted

to Congress, these include the compulsory recording of all contracts concerning patents, the creation of a single court of patent appeals, the licensing of patents relating to national defense, a declaration of policy with respect to testing patentability and invention, and, finally, empowering the Patent Office to report on the validity of patents involved in suits for infringement.

Congressman Boykin of Alabama, chairman of the House Committee on Patents, has served notice that he will undertake the preparation of bills to effectuate the recommendations of the NPPC. In a letter to the Speaker of the House he said that their immediate enactment into law would be a contribution to our strength in the war and an invaluable assistance to American industry, commerce, and labor after the return of peace.

Synthetic Rubber Program

When completed, facilities for the manufacture of synthetic rubber, a three-quarter billion dollar chemical industry, will have been built practically within a year's time. A report on the position of the program in mid-July showed it to be 30 percent complete and that early in September it will be 75 percent complete. The entire construction program will be out of the way by the end of the year. The difficulty being experienced in July was in production of styrene. Indications were that the program would be again in balance late in August.

The annual capacity will be approximately 850,000 long tons. Estimates of annual capacity remain about the same although as individual plants come into production their capacities often exceed what was expected. Experience indicates that gains and losses in plant capacity offset each other leaving the capacity of the entire industry about as originally planned.

Fabrication of this tremendous volume of synthetic rubber will be a question of manpower and facilities. Companies that will convert raw synthetic rubber into war material have lost much of their personnel to other war industries. It is indicated that tire manufacturers now have only about 30 percent of the passenger tire capacity they had in prewar times because of conversion facilities and loss of manpower.

Automobile tires of the pre-Pearl Harbor vintage was the result of years of experience. It took the compounders of natural rubber 30 years to develop tire-making to the high art of present day manufacture. The construction of tires from synthetic rubber must go through a similar though shorter development period before tire performance will equal what the public has learned to expect from tires of natural rubber.

Rayon vs Cotton Cords

Controversy over the use of rayon cords rather than cotton cords in the manufacture of tires continues to rage. Proponents of the cotton cord insist that the recent action of the War Production Board which approved an expansion in the facilities for the production of high tenacity rayon by 68,000,000 lb. a year will result in economic distress for the cotton planters.

Testimony presented before the Senate Agricultural Sub-committee aimed to discredit the tests made by the Army Motor Transport Corps upon which the decision to use rayon cord was made. It is difficult to evaluate the claims and counter claims. However, the argument that cotton linters, the raw material for manufacture of rayon, "are a critical material badly needed in the manufacture of munitions" was knocked sky high by an amendment to Order M-12. Before the amendment all linter production had to be delivered to Commodity Credit Corp. for use in chemical cotton pulp. The amendment permitted sales of cotton linters on the open market for use in the manufacture of bedding and upholstery. Rubber Director Jeffers is holding his ground on the statement that synthetic rubber in truck and heavy duty tires built by the latest methods generates more heat in operation than tires for similar service made of natural rubber. It is claimed that the rayon cords are better able to stand the high temperatures. Mr. Jeffers also says that if the Army wants rayon, as far as he is concerned that is what the Army will get.

At the moment passenger tires are made without use of any natural crude rubber, but the technique of handling synthetic has not progressed to a point where truck and heavy duty military tires can be made with less than 30 percent of crude.

Future price of synthetic rubber will be determined by technological developments and possible sale of petroleum by-products obtained in the manufacture of butadiene, according to the general belief of technical experts in the Office of the Rubber Coordinator. Estimates now are that the ultimate cost will be down to someplace between 8 cents and 12 cents a pound, 12 cents being considered a good guess. These estimates are made on the assumption that much cheaper butadiene will be made from petroleum or from alcohol produced from ethylene or byproduct molasses.

Maintenance and Repair

Record on maintenance, repair and operating supplies may be kept on the "receipt" or the "order" basis by the chemical industry. This applies to firms operating under CMP Regulation No. 5 as well as those operating under P-89. This was made known to the industry through Direction 8 of CMP Regulation 5, which also contained the additional provision that only one method could be used by any firm.

As originally written, both CMP Regulation 5 and the chemical industry's repair and maintenance order P-89 specified that records should be kept on the order basis. This method met the requirements of all but a few concerns. Direction 8 was the outcome of the hardship claims of those few.

Since P-89 says definitely that records should be kept on an order basis, chemical operators securing maintenance and repair materials under its terms must notify the administrator of the order if they intend to keep their records on the receipt basis. Only one method may be used under P-89 as is the case with CMP Regulation No. 5.

Ambiguity of CMP Regulation 5 with respect to the $500 limitation on repair and replacement items has been cleared up by Interpretation No. 8 of that regulation. It reads as follows. "Products or materials needed for repairs or replacements which are capitalized cannot be obtained under CMP Regulation No. 5 (3175.5) except to the extent permitted by paragraph (b)(3) of the regulation relating to minor capital additions costing less than $500."

This means no capital item valued at over $500 may be obtained by chemical producers securing their maintenance, repair and supplies under the terms of CMP Regulation 5, whether the item is for replacement or not. This conforms with and gives legal force to an example previously cited in this column (see *Chem. & Met.*, June 1943, p. 150).

This interpretation of CMP Regulation 5 is in conflict with the terms of P-89. Under Order P-89, replacements of capital items valued at more than $500 are permitted if the piece is worn beyond economical repair or if it is urgently needed for standby. Such additions are not permitted under Order P-89 if they are solely for increasing plant capacity.

Increase in Plant Capacity

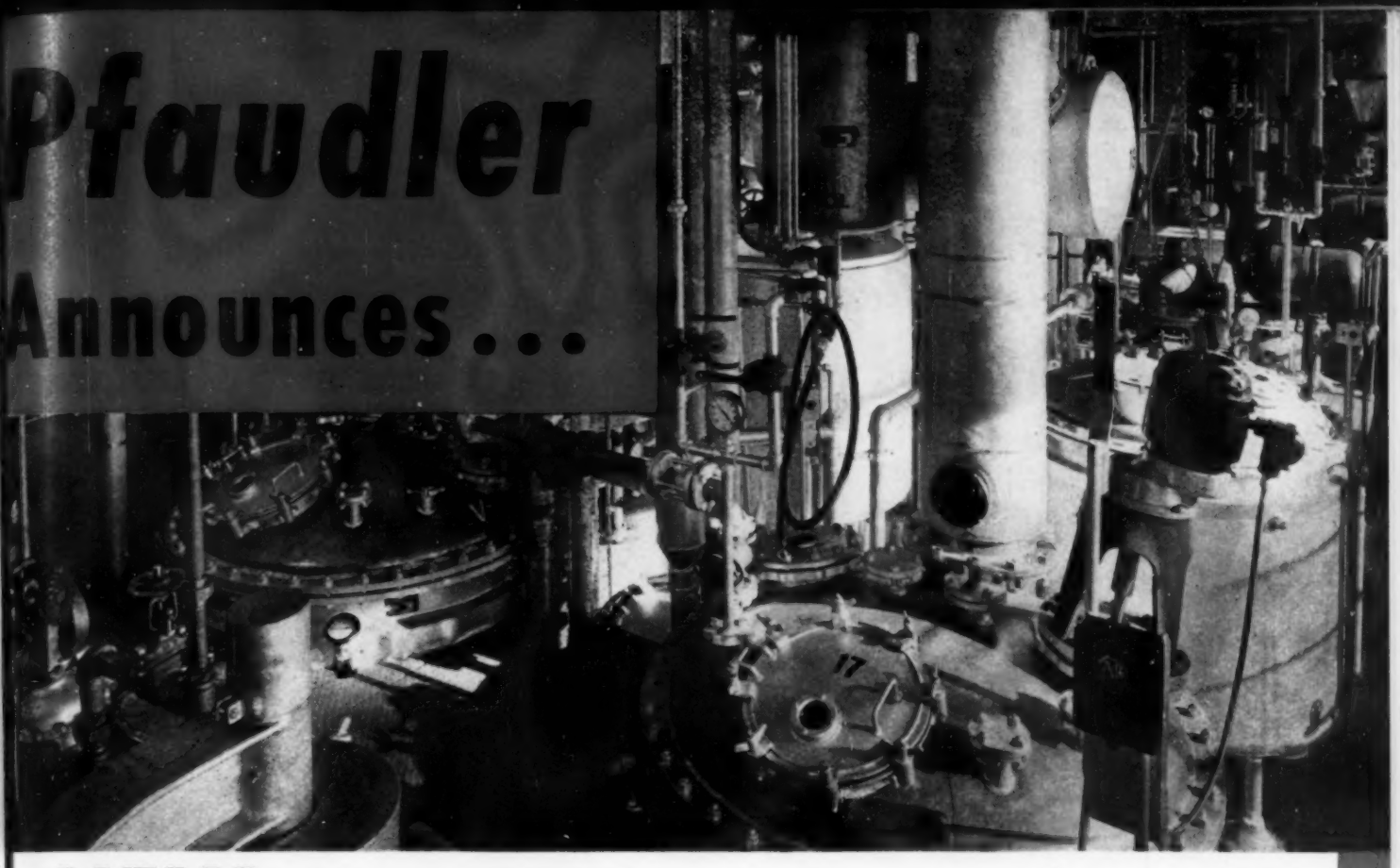
For increases in plant capacity, special applications may be made on form WPB 541, formerly PD-1-a, or WPB 617, formerly PD-200, and other forms which may be prescribed by the regulations.

Some chemical producers have requested the Chemical Division of WPB for an allotment of controlled materials for the fabricators of maintenance and repair items ordered by the producers. This is unnecessary. The fabricators who have not had allotments for controlled materials—steel, copper, and aluminum—for the manufacture of MRO items for the chemical industry can secure such an allotment by filing a request on form CMP 4B. This is in accordance with the provisions of CMP Regulation No. 1, Paragraph (d)(6).

Chemical producers should call their suppliers' attention to Priorities Regulation No. 3 which governs the application and extension of preference ratings. The terms of this regulation supersede any of the conflicting provisions of P-89, CMP Regulation 5 or any of the other repair and maintenance orders that may be used.

The Controlled Materials Plan is working out. Top WPB officials have indicated their satisfaction with the system. This does not mean that there will be no changes, for some are already in sight for next year which are designed to make the plan better meet the requirements of industry. There will be changes in the "B" list, done at the behest of the services, which will cut the number of items materially. During July there was more difficulty in scheduling the manufacture of component parts than of critical materials.

Pfaudler Announces...



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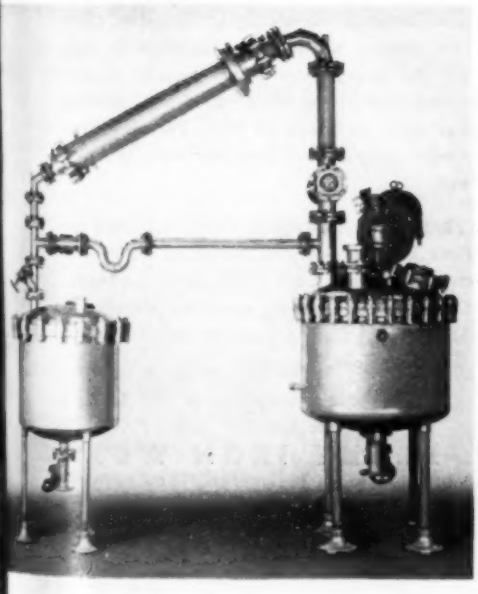

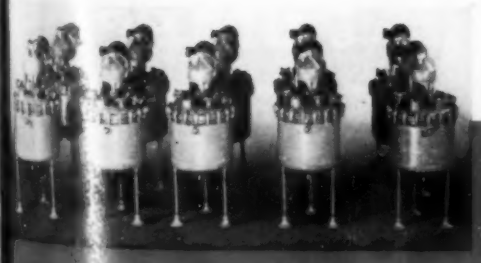

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PUMPS

INTERPRETING WASHINGTON

EDITOR'S NOTE: *Copies of the orders, rules and regulations covered in this installment may be obtained by writing to the appropriate federal agency, citing the order number or release date.*

CONTENTS

Heat Exchangers 145
Extended Surface Heating Equip 145
Resistance Welding Equip 145
Welding Rods 145
Wooden and Fibre Containers 145
Wooden Barrels 145
Steel Shipping Drum Sales 145
Steel Shipping Drum Uses 145
Rotenone Distribution 146
Oils for Protective Coatings 146
Dyestuffs and Organic Pigments 146
Chlorinated Refrigerants 147
Cellulose Esters 147
Furnace Type Carbon Black 147
Toluene 147
Neoprene Rubber 147
Guanidine Carbonate 148
Penicillin 148
Sulphamic Acid 148
Benzene 148
Pulpwood 148
Cadmium 148
Aniline 148
Pyridine 149
Petroleum Solvents 149
Carbon Tetrachloride 149
Butyl Alcohol and Acetates 149
Dibutyl Phthalate 149
Miscellaneous Chemicals 149

HEAT EXCHANGERS

General Limitation Order L-172 was amended on July 9 by WPB to revise the restrictions on heat exchangers. Critical heat exchangers are divided into two groups, Group I including all tubular heat exchangers except for use on shipboard or in a refrigerating or air-conditioning systems as defined in Order L-38. Group II heat exchangers include all critical heat exchangers that are not covered by Group I. Purchase orders for Group I critical heat exchangers must be accompanied by a specific authorization on Form WPB 1475 (PD-615), or on Form PD-615A. Purchase orders for Group II exchangers must bear a preference rating of AA-5 or higher.

If a person is unable to obtain delivery of a Group II critical heat exchanger he may make application in the same way as for a Group I exchanger. The WPB reserves the right to cancel any order, change delivery schedules, revoke authorizations or take any other action as is deemed necessary.

EXTENDED SURFACE HEATING EQUIPMENT

General Limitation Order L-107 was amended by WPB on July 28 to restrict distribution of extended surface heating equipment to "Approved Orders"—those which specify a delivery date, are rated AA-5 or better, or which are for repair parts. The amended Order also arranges for better distribution of purchase orders among manufacturers in the event of a bottle neck, and reduces the number of sizes and types of extended surface heating equipment which may be made.

RESISTANCE WELDING EQUIPMENT

General Limitation Order L-298, Part 1226, was amended on July 27, providing that orders received after that date for any new resistance welding equipment may not be filled unless specifically authorized by WPB. Application for an authorization, and for a preference rating if none has been previously assigned, should be made by the purchaser on Form WPB-2752, in duplicate. These delivery restrictions do not apply to (1) any order of $200 or less, (2) any order for resistance welding electrodes, (3) orders for direct use by the Army, Navy, Maritime Commission or War Shipping Administration, (4) any order bearing a preference rating assigned under Preference Rating Order P-19-h, or (5) orders placed by manufacturers or dealers in resistance welding equipment.

WELDING RODS

Direction No. 10 to CMP Regulation No. 5 was issued on July 28 by WPB to assign a preference rating of AA-2 to repair shops for the acquisition of welding rod. This rating may be used regardless of whether or not the shop keeps welding rod as an operating supply. The rating may be used to buy as much welding rod as was used in the previous month, up to $100. However, there are no restrictions on purchases up to $15 in any one month. If more welding rod is required than can be obtained through the use of the AA-2 rating, a repair shop may buy the additional rod by (1) use of a customer's rating for a specific job, (2) applying for a specific amount of rod on Form PD-1A, (3) if the shop also needs controlled material, by filing Form CMP-4B and using the rating assigned for all the welding rod it needs.

WOODEN AND FIBER CONTAINERS

Preference Rating Order P-140 was amended on July 14 by WPB to clarify the meaning of "shipping container" and "part." The new definition includes any corrugated or solid fiber sheet or roll to be used for wrapping or packaging or otherwise protecting a product or material for shipment. Neither shipping container nor parts include any corrugated or solid fiber sheet intended for use in the manufacture of shipping containers or parts by concerns commonly referred to in the industry as "sheet plants." Otherwise there is no change in the original Order.

WOODEN BARRELS

MPR-424 was issued on July 9 by OPA providing specific dollars-and-cents maximum prices for "tight" wooden barrels and the wooden parts used in their manufacture. "Tight" wooden barrels are stout casks made of white oak, chestnut oak, red oak, gum, ash or elm cooperage stock, and constructed and finished off so that they will hold aging whiskey, oil products and other liquids. While primarily designed for liquids, some grades are employed by industry for shipping metals, ores, and other dry products. Previously all barrels were priced under the GMPR, which provided that the seller's ceilings were the highest prices he charged during the month of March, 1942.

STEEL SHIPPING DRUM SALES

General Preference Order M-255 was amended on July 17 by WPB to extend control of steel shipping drums to cover "rejects" or "seconds." As of the above date no manufacturer may sell or deliver any "rejects" or "seconds" in excess of three-quarters of 1 percent of his monthly production of new steel drums, except pursuant to specific authorization by WPB. The Army, Navy, Maritime Commission and War Shipping Administration are excepted. Prices for these drums must conform to any applicable maximum price regulations, and in no case may exceed the unit price of the original contract for which they were made.

Users who desire to purchase these "rejects" or "seconds" should file Form PD-835 with the WPB. Manufacturers who wish to sell to a person other than a user shall apply for WPB authorization by letter, giving the information outlined in the Order.

STEEL SHIPPING DRUM USES

Limitation Order L-197 was amended on July 14 by WPB to permit the use of steel shipping drums for 16 additional chemicals. Products which formerly were listed under A and B are consolidated into one list, Schedule A. Under this amendment the majority of products which formerly were on list B may now be packed in used drums regardless of the date on which the drums were purchased. Since substitute packages are now available for corn syrup, molasses and fruit juices, the use of new or used steel drums for these products is prohibited.

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ROTENONE

Conservation Order M-133 was amended by WPB on July 6 eliminating the provisions which controlled the distribution and use of rotenone insecticides for agricultural purposes. These are now regulated by Food Production Order No. 13. The amended Order continues its former restrictions on the processing and manufacture of rotenone insecticides.

OILS FOR PROTECTIVE COATINGS

Conservation Order M-332 was amended by WPB on July 27 to clarify the definitions of wholesalers and retailers, and revise restrictions on deliveries.

A wholesaler means a person who buys linseed or fish oils from a crusher or processor, and without further processing resells such oils to manufacturers or retailers. A retailer is any person who sells linseed oil or fish oil to the ultimate consumer.

Deliveries which are now freed from the former restriction include (1) deliveries of linseed oil or fish oil which on July 1, 1943, and at the time of the delivery were packaged in unopened five-gallon cans or smaller containers and were on both of these dates owned by the person making delivery, (2) deliveries of boiled linseed oil packaged in 55-gal. drums or smaller containers under the same conditions, (3) deliveries by any wholesaler of raw linseed oil (in no case in a quantity exceeding 1375 gal.) packaged in unopened drums or containers having a capacity of more than 8 gal., but not more than 65 gal., under the same conditions, and (4) deliveries to the Army, Navy, etc. An additional statement requires that no person shall deliver or sell any material represented to be "linseed replacement oil," unless such material meets the requirements of Federal Specification TT-O-371.

DYESTUFFS AND ORGANIC PIGMENTS

Conservation Order M-103 was amended on July 5 by WPB to bring under control all but four of the remaining approximately 250 colors previously unrestricted. The four dyestuffs which are excluded from the provisions of the order are the "Lake colors" Lithol Red CI 189, Azo Bordeaux CI 88, Alphanaphthylamine Maroon CI 82, and Pigment Green B.

Authorized deliveries for any calendar quarter may be made up to and including the twenty-first day after the end of that quarter. The restriction on the value of dyestuffs which may be exported or delivered for export from the United States to all places other than Canada is now placed at 15 percent of the total value thus sold during 1941.

By a further amendment on July 29, Canada was exempted from quota and export restrictions in the Order.

CHLORINATED REFRIGERANTS

Conservation Order M-28 was amended by WPB on July 10, to tighten up the restrictions on chlorinated hydro-carbon refrigerants, or Freon. Their use is now entirely forbidden for comfort cooling

systems, skating rink systems and refrigerating systems used solely for storing or dispensing carbonated or malt beverages. The uses of chlorinated hydrocarbon refrigerants are grouped into eight classes for the purpose of certification of purchase orders. The certification outlined in the Order must be used by any person seeking delivery from a buyer, who in turn must file the specified certification with the "Contract Agent," who acts on behalf of the producer.

CELLULOSE ESTERS

Supplementary Allocation Order No. M-326-a was amended on July 9 by WPB to state that allocations under this Order refer to the month when the materials for the production of cellulose and plastics are to be put in process, rather than to the month of actual delivery, except when deliveries are to be made from existing stocks. The provisions printed in the WPB 2947 (formerly PD-602) Form for automatic termination of authorization shall not be applicable to authorized deliveries of cellulose plastics.

FURNACE TYPE CARBON BLACK

General Preference Order M-244 was amended by WPB on July 20 to become Allocation Order M-244. As the Order now reads, delivery of between 100 and 5,000 lb. of furnace type carbon black in the aggregate from all suppliers during any one month does not require specific WPB authorization. However, purchase orders for such deliveries must be accompanied by a certificate pursuant to Appendix C of the order, giving the essential information. The Order also states that furnace type carbon black may not be used except in compounding rubber, unless specifically authorized by WPB. Specific authorization may be applied for by using Form WPB-2945 (formerly PD-600). Suppliers seeking to make deliveries must file with the WPB, Form WPB-2947 as instructed by Appendix A of the Order.

TOLUENE

General Preference Order M-34 was amended by WPB on July 23 to become Allocation Order M-34. Included in the amendment is a provision for laboratories to use and accept delivery of 5 gal. or less of toluene in any month without specific authorization. In addition, government-owned plants may use toluene in the production of explosives, may accept delivery from any person for this purpose, or may deliver to a government-owned explosives plant without specific authorization.

NEOPRENE RUBBER

MPR-149, amendment 12, issued on July 14 by OPA, provides new reductions in the maximum prices of Neoprene rubber hose and Neoprene rubber belting to reflect the decreased cost of Neoprene. Dollars and cents prices are listed for most of the common sizes, and a method is given for arriving at the ceiling prices of constructions and sizes of the specified hose not listed in the table.

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Split Phase ..... 1/30 to 1/3 h.p.
Direct Current ..... ½ to 3 h.p.

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GUANIDINE CARBONATE

Revised Supplementary Regulation No. 14, amendment 4, was issued on July 24 by the OPA, providing new and higher price ceilings for guanidine carbonate to cover actual production costs. The new ceilings, ranging from 57 cents per pound when sold in carload lots, to 73½ cents per pound in quantities under 50 lb., are approximately 50 percent higher than the replaced ceilings set under the GMPR.

PENICILLIN

Allocation Order No. M-338 was issued by WPB on July 9 to control the delivery and use of the new chemotherapeutic agent, Penicillin. Producers or distributors seeking authorization to deliver Penicillin must file Form WPB-2947 with the Chemicals Division of the WPB. Proposed deliveries and intended uses must be recorded on this form.

SULPHAMIC ACID

General Preference Order M-242, originally issued on Oct. 3, 1942, was revoked by WPB on July 6. Increased production of sulphamic acid and its derivatives has increased supplies sufficiently to permit this action.

BENZENE

Conservation Order M-137 was amended by WPB on July 23 to become Allocation Order M-137. Any person accepting delivery of not more than 50 gal. of benzene per month must now furnish his supplier and the WPB with a certificate to that effect, as instructed in Appendix C of the Order.

PULPWOOD

MPR-348, amendment 5, issued on July 9 by OPA, covers all purchases of logs and bolts subject to this regulation by plants which convert logs or bolts into finished or unfinished wood or chemical products. The amendment, which became effective July 14, provides that maximum prices shall be established as the "average prices paid by buying plants for each species and grade of logs and bolts during September and October, 1942."

CADMIUM

Conservation Order M-65-a was amended by WPB on July 27 to prohibit the use of cadmium in the manufacture of pigments, except for military use and some essential civilian uses.

ANILINE

Allocation Order M-184 was amended by WPB on July 5, providing for the use of Forms WPB-2945 and 2947, formerly PD-600 and 602. Users of aniline who require more than 5,000 lb. per month must apply for WPB authorization on Form WPB-2945, as instructed in Exhibit B of the Order. Users who require between 500 and 5,000 lb. per month must certify to their suppliers the amount required and intended end uses as instructed in Exhibit C of the Order. Suppliers seeking authorization to make

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McGraw-Hill Mailing Lists, used by leading manufacturers and industrial service organizations, direct your advertising and sales promotional efforts to key purchasing power. They offer thorough horizontal and vertical coverage of major markets, including new personnel and plants. Selections may be made to fit your own special requirements.

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delivery of aniline must file Form WPB-2947 as instructed in Exhibit A of the Order. For orders of 500 lb. or less in the aggregate during any calendar month no specific authorization is required.

BUTYL ALCOHOL AND ACETATES

MPR-37, amendment No. 6, issued by OPA on July 16, establishes maximum dollars-and-cents prices for grain fermentation alcohol and acetate when the average base cost per bushel of whole grain (corn or wheat) is $1.22, provision being made for upward or downward fluctuations. The ceiling for molasses butyl alcohol is set at 18.5 cents per pound and for molasses butyl acetate at 18 cents per pound.

DIBUTYL PHTHALATE

MPR-37, amendment No. 7, issued by OPA on July 29, provides a sliding scale of maximum prices for dibutyl phthalate. A separate list of base prices is included in a new appendix to the regulation and provision is made for adjusting prices depending on the cost of butyl alcohol.

CARBON TETRACHLORIDE

Revised Price Schedule No. 79 was redesignated MPR-79 by OPA on July 30 and revised to change transportation provisions applicable to reseller's sales of carbon tetrachloride.

PYRIDINE

Allocation Order M-185 was amended by the WPB on July 29 to eliminate the use of special allocation forms, and to substitute the standard forms PD-600-601 commonly used for chemicals.

PETROLEUM SOLVENTS

Allocation Order M-150 was amended by WPB on July 28 to include high flash naphtha with the petroleum solvents already under allocation. High flash naphtha is defined as water white coal tar solvent naphtha refined from coke oven light oil, coal tar distillate, drip oils or holder oils. The amendment also increases the small order exemption for petroleum solvents, with the exception of high flash naphtha, from 60 gal. to 550 gal.

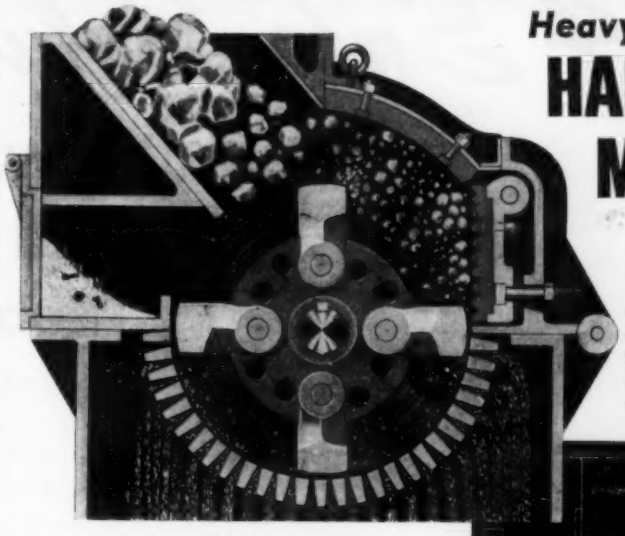
MISCELLANEOUS CHEMICALS

Allocation Order M-340, was issued by WPB on July 26, to control the delivery and use of four denaturants commercially known as (1) acetaldol, (2) ST-115, (3) Dehydrol-0, and (4) G.C.-78. Suppliers who desire authorization to make delivery must file with the WPB Form PD-602, listing each customer and his requirements. Customers must certify to their supplier the amount and intended use of the chemical covered by this Order. An exception for small deliveries permits a supplier to ship to any one customer in any one month 54 gal. of any one of the chemicals without specific authorization. However, the aggregate quantity of these small orders must not exceed the quantity which WPB has specifically authorized for that purpose on Form PD-602.

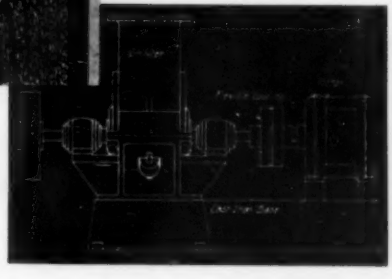
WILLIAMS

Heavy-Duty HAMMER-MILLS

Cap. 50 LBS. to 300 TONS per Hour



Williams Hammer Grinder direct connected to motor, all mounted on heavy cast base. This type of drive is economical to operate and easy to install.



SECTIONAL VIEW

Sectional view of Williams over-running hammermill, with heavy liners and grinding plate for limestone and other hard material. Particular attention is directed to the grinding plate adjustment which assures uniform close contact of hammers and grinding plate at all times. Also note the metal trap which provides an outlet for the escape of tramp iron.

Economically reduces animal, mineral and vegetable matter . . . grinds chemicals to 400 mesh . . . shreds steel turnings . . . crushes 4 feet cubes of rock—

Williams is the world's largest organization of Crushing, Grinding and Shredding specialists and have developed standard machines for the reduction of practically every material whether animal, mineral or vegetable. Capacities range from 50 pounds to 300 tons per hour permitting selection of exactly the proper size for your work. Whether you wish to grind chemicals to 400 mesh, crush 4 feet cubes of rock or shred steel turnings, you can profit by Williams experience.

THE WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 North Ninth St. St. Louis, Mo.

Sales Agencies Include

Chicago, 37 W. Van Buren St. — New York, 15 Park Row — Oakland, Calif., 1629 Telegraph Ave.

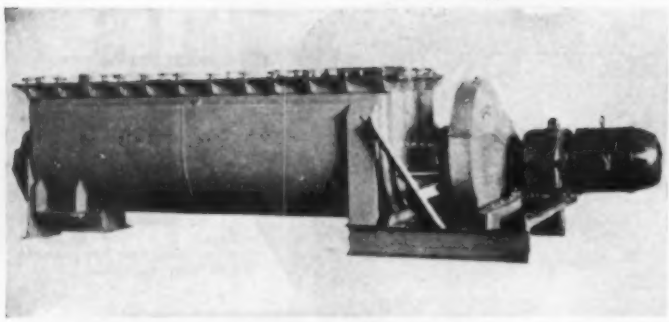
Williams — OLDEST AND LARGEST BUILDERS OF HAMMERMILLS IN THE WORLD

PATENT CRUSHERS GRINDERS SHREDDERS

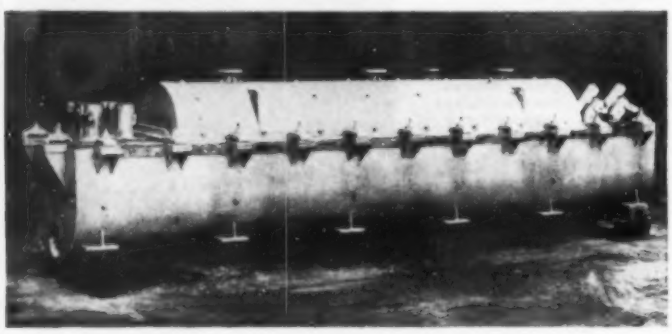
★ ★ CONSERVE STRATEGIC METALS WITH LUKENS CLAD STEELS ★ ★

A Safe Solution

to Wartime Corrosion and Contamination Problems



DYESTUFF MIXER — Horizontal mixer for handling dry dyestuffs built on repeat order by Sprout, Waldron & Company, Inc., Muncy, Pa. Fabricated from 3/16" and 13/32" 10% and 20% Lukens Nickel-Clad Steel.



PHENOL REACTOR — This tank of 20% Lukens "L" Grade Nickel-Clad Steel was built by Steel and Alloy Tank Company, Newark, N. J., to handle fused caustic in synthesis of phenol by the benzene sulphonic acid fusion method. Dimensions of the vessel, completely sheathed and lagged, are 2' 0" x 3' 0" x 16' 0".

EVAPORATOR HEATING SECTION — This heating section for a forced circulation vacuum evaporator for concentrating caustic soda solution was fabricated by Swenson Evaporator Company, division of Whiting Corporation, Harvey, Ill., from ½" and 1¼" 20% Lukens Nickel-Clad Steel.

Lukens Clad Steels have been in service in a wide variety of applications for a number of years, definitely establishing the fact that the clad layer of nickel, Inconel or Monel retains all the corrosion-resisting, product-protecting qualities of these metals in solid form. Now, with the expanded wartime requirements for nickel, Inconel and Monel, the advantages of Lukens Clad Steels can be more fully realized.

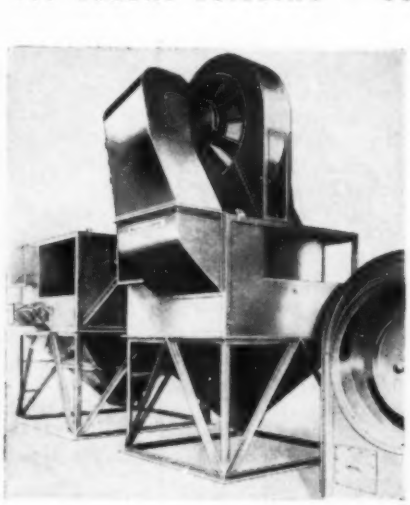
While they save from 80% to 90% of these strategic metals with consequent cost reductions, Lukens Clad Steels can safely be used in the handling of sensitive and corrosive materials wherever the specific properties of nickel, Inconel or Monel are required.

These facts are worth remembering when designing equipment which calls for corrosion resistance and chemical stability.

LUKENS STEEL COMPANY

World's Largest Plate Mill

197 LUKENS BUILDING • COATESVILLE, PA.



CHEMICAL VENTILATOR —Combined exhauster and dust precipitator built by American Air Filter Company, Louisville, Ky., removes gases at rate of 10,000 c.f.m. and reclaims chemical dust. Fabricated from ¼" thick 20% Lukens Inconel-Clad Steel.

Write on your company letterhead for this interesting bulletin of Lukens Clad installations and helpful reference data on Clad Steels.

Lukens NICKEL-CLAD CLAD INCONEL-CLAD Steels MONEL-CLAD

NEW PRODUCTS AND MATERIALS

CONTENTS

Nylon as a Plastic 151
Trialkyl Phosphates 151
Metal to Metal Adhesive 151
Reconditioner for Anti-Freeze 151
Raw Material for Synthetic Rubbers. 151
Cleansing Cream 152
High Impact Molding Plastic 152
A Synthetic Resin 152
Waterproof Match 152
Cellulose Finish 152
Non-Porous Electrical Porcelain 153
Di-Butyl-Cresol 153
Hygroscopic and Sweetening Agent .. 153
Plastics That Conserve Phenol 153
Conductive Flooring 154
Algae Killer 154
N-Butyraldoxime 154
Plasticizer for Synthetic Rubbers 154
Wetting Agent 155
Finish for Cotton Fabric 155
Rubber Electrical Semi-Conductor 155
Balsamic Esters of Resin 155
Synthetic Rubber 156
Synthetic Rubber Extruded Parts 157
Vitamin 157
Dusting Powder 157
Powder for Wet-Grinding Operations. 157

Nylon as a plastic will enter a vast, new field after the war

NYLON AS A PLASTIC

After the war, nylon plastic will be available, according to an announcement of the Plastics Department, E. I. du Pont de Nemours & Co., Wilmington, Del. Small quantities of nylon have been allocated by WPB for plastic articles of direct military significance. The present nylon plastic does not soften until the temperature reaches around 450 deg. F. This approximates the charring point for some thermosetting materials, but other nylon plastics having even higher softening points may be formulated. It is exceptionally tough, especially where sections must be thin and strength great. It is one of the lightest plastics in weight. Its specific gravity is 1.06-1.19. Time has little effect on it. It does not rot or deteriorate with age. Sunlight has slight effect. It is inert to metal inserts when combined with them in finished products. Its chemical resistance compares favorably to that of other thermoplastics; oil, grease, most solvents, alkalis and weak acids do not attack it.

TRIALKYL PHOSPHATES

Here is a series of organic phosphorous compounds made by Victor Chemical that may be useful in plasticizers, coolants, alkalating agents and solvents. The characteristics are listed in the accompanying table.

METAL TO METAL ADHESIVE

A new bonding process that unites metals with a bond stronger than riveting or spot welding, and that joins rubber, plastics, leather or wood, to metals, or to each other with a bond stronger than the materials themselves, has been announced by U. S. Stoneware Co., Akron, Ohio. Application of the Reanite process is said to be simple. The surfaces to be joined are brushed, sprayed or dipped with Reanite. After drying, mild heat and pressure are applied. The joint is unaffected by fresh or salt water.

Specifications and Properties of Trialkyl Phosphates

Compound	Sp. Gr. at 25 deg. C.	Boiling Range at 20mm. deg. C.	Melting Point deg. C.	Titn *	Flash Point deg. F.	Solubility** Water	Alcohol	Acetone	Ether	Toluene	CCl_4	Naphtha
Trimethylphosphate	1.217	85–90	—45	0.1	350	S	S	S	S	S	S	I
Tri-n-propyl phosphate	1.012	135–140	Fluid at —80	0.1	300	I	S	S	S	S	S	S
Tri-n-amyl phosphate	0.947	195–200	Viscous at 80	0.5	300	I	S	S	S	S	S	S
Trioctyl phosphate	0.930	.....	Very viscous at —80	...	300	I	S	S	S	S	S	S

*cc 0.1 N NaOH/10 cc sample
** S=soluble, I=insoluble

RECONDITIONER FOR ANTI-FREEZE

A chemical inhibitor for reconditioning last winter's anti-freeze solution is now available to car owners according to the Chemical Specialties Division of du Pont company. It is being released for civilian use in cooperation with a WPB request that motorists conserve their old solutions.

RAW MATERIAL FOR SYNTHETIC RUBBERS

Recently developed by Reilly Tar & Chemical Corp., Indianapolis, is a material which offers possibilities in the development of synthetic elastomers. It

Four Three distinct blending actions!

GIVE EXACTNESS IN DRY BLENDING

RECEIVING

DISCHARGING

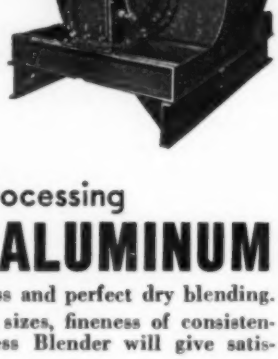
IN THE STURTEVANT DRY BATCH DUSTLESS DRY BLENDER

1—As materials enter drum, they are *first* blended by being picked up and carried to the top of the drum by revolving buckets, where they are cascaded and intimately mixed. Then

2—Materials are forced from both ends to the middle of the revolving drum, NOT separated. Then

3—The overall revolving action of the drum itself adds mix number three. Finally

4—A swinging chute inside the drum adds an important FOURTH lateral mixing motion.



★ Ideal for Processing

PLASTICS *and* ALUMINUM

or any other materials requiring dustless and perfect dry blending.

No matter what the weights, densities, sizes, fineness of consistencies, the Sturtevant Dry Batch Dustless Blender will give satisfaction.

Light substances do not float and remain unblended. Scientifically blends materials, 1st, to a definite chemical analysis; 2nd, various sizes together; 3rd, colors to a precise exactness. Leak-proof because dustless construction. No internal moving parts to break down original composition of material intake and discharge through same opening.

Send for Bulletin 080-B

Sturtevant MILL COMPANY
HARRISON SQUARE BOSTON, MASS.
CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS
MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS

is 2-vinylpyridine, which is the pyridine analog of styrene. This chemical e... polymerizes similarly with butadien... and styrene, and with butadiene an... styrene together, to form an elastome...

CLEANSING CREAM

A new non-toxic cleansing crea... produced by Dennis Chemical Co., St. Louis, is called Den-Tex. The cream i... used for cleaning the hands. It is firs... worked into the paint or other materia... on the hands, and then rinsed off.

HIGH IMPACT MOLDING PLASTIC

The development of a high impact, re... sistant molding material RM-16468 ha... been announced by Bakelite Corp., uni... of Union Carbide and Carbon Corp., Ne... York, N. Y. It is a black phenolic plas... tic having a string filler, rather tha... chopped fabric, which is employed fo... other types of shock-resistant materials. Impact strength of this material is abou... 20 to 25 times greater than general-pur... pose phenolics. Molded test specimen... indicate the material has the following physical properties:

		Direction of Stress	
Compressive strength, lb per sq in		Parallel	27,500-32,70...
		Transverse	15,600-18,20...
Tensile strength, lb per sq in...		Transverse	7,500- 8,90...
Flexural strength, lb per sq in.		Parallel	12,000-12,90...
		Transverse	10,200-14,30...
Maximum deflection — inches..		Parallel	.085- .12...
		Transverse	0.95 - .1...
Impact strength, Izod. Energy to break — ft.-lb. per inch of notch		Parallel	3.49 - 4.94

A SYNTHETIC RESIN THAT INCREASES WET-STRENGTH OF PAPER

Developed in the research laboratories of the Resinous Products & Chemical Co., Philadelphia, Pa., this new addition to the Uformite family is designed for application at the wet end of the paper machine. It is said that Uformite 466 not only increases the wet strength of paper, but also improves dry-strength as well. It requires no mixing or compounding, no changes in processing. It is simply a matter of adding the resin solution to the stock before or after the alum addition. It is a urea-formaldehyde resin.

WATERPROOF MATCH MADE WITH NEW PAINT

A moisture-proof match that will ignite even after it has been immersed in water for four hours or carried through a steaming jungle for five days has been developed for American fighters in tropical areas, who now carry kitchen-type matches. According to *Witcombings*, tests have shown that the moisture-proof paint used on the heads of the new matches will protect the matches for five days in a tropical chamber with a temperature of 100 deg. and a humidity of 95 percent. The paint for the match head was developed by the National Bureau of Standards.

CELLULOSE FINISH

One of the new products that has recently been announced is Kopan, a permanent cellulose finish, developed by the Hart Products Co.; it is suitable for

sheets, damasks, shirtings and many types of knitted and woven plastics. It imparts to each fiber a permanent coating which adds to durability, strength and appearance. It minimizes shrinking and stretching in laundering and dry cleaning. The fabrics treated with it are more resistant to abrasion and wear.

NON-POROUS ELECTRICAL PORCELAIN

Non-porous electrical porcelain may be made by a new process. Prestite, as the name implies, is pressed in a metal die in a hydraulic press. By proper application of ceramic materials, non-porous ceramic ware is produced. Such ware produced in steel dies provides greater dimensional fidelity than other methods. This advantage, coupled with the fact that ceramic ware can now be produced complete in one operation, makes this new process different from other processes. A variety of composition of bodies may be used and intricate shapes may be made. The new method makes use of specially sealed metal dies which are evacuated down to within 2 cm. or less, according to Mr. Fischer of the Westinghouse Electric & Mfg. Co., Derry, Pa.

DI-BUTYL-CRESOL

In compounding certain types of synthetic rubber, it is suggested that 4, 6-di-tertiary-butyl-m-cresol may be used. This material may also prove satisfactory as a softener and plasticizing agent, and may be used to improve tack. It may be used in the manufacture of resins, particularly because of its oil solubility. It is suggested for use as an anti-skinning agent for paint and varnishes, by the producer, the Koppers Co., Pittsburgh, Pa.

Properties: (Pure Compound)

Molecular weight..... 220
Melting point..... 62.5 deg. C.
Boiling point:
at 100 mm. (approximate)..... 171 deg. C.
atmospheric (approximate)..... 285 deg. C.
Specific gravity at 50/50 deg. F..... 0.920
State: Light-colored semi-solid, crystalline, mild odor.
Solubility: Practically insoluble in water. Easily soluble in alcohol, benzene, gasoline and carbon tetrachloride. Insoluble in caustic alkali solutions.

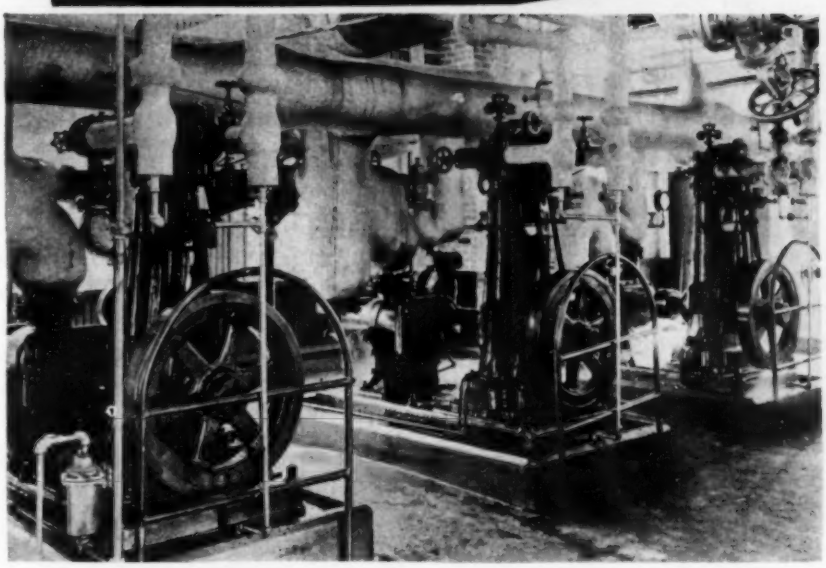
HYGROSCOPIC AND SWEETENING AGENT

For properties and process please turn to page 104.

PLASTICS THAT CONSERVE PHENOL

Several new Bakelite phenolic molding plastics which help to conserve the supply of phenol have been announced by Bakelite Corp., Unit of Union Carbide and Carbon Corp., New York, N. Y. These materials may be used for many purposes where it is not necessary to meet exacting government specifications. BM-15983 Black, BM-16044 Brown, and BM-16325 Black were developed for uses that formerly required general-purpose phenolics. BM-16749 Black, BM-

STEAM ENGINES can act as Chauffeur as well as Fireman often get the most work out of steam in both capacities



TOO often process plant operators look upon steam, once it has left the boiler, as a source of BTU's only. They overlook its by-product power possibilities.

The actual fact is that steam can—and usually should—be used twice: first for power and then for heating. In short, steam should function first as a "chauffeur" driving some sort of process equipment and then as "fireman" to provide heat units for processing or heating.

That saves on costs.

TROY ENGINE & MACHINE CO.
1317 Railroad Avenue Troy, Pa.
S-TEM-5

Segmental Design + Heat Resistant Alloy = *Less Maintenance and More Product*

Most of the users of Amsco Alloy segmental rings for kiln feed and discharge ends are cement producers, but some of them are makers of lime and heavy chemicals. Without any exception we know of, all of them agree that the combination of heat-resistant chromium-nickel alloy with a good segmental design is unequalled for effecting continuous kiln operation and low maintenance cost. Repeat orders are one evidence of this fact.

The temperatures to which kiln rings are subjected are so high that ordinary metals soon show permanent "growth" or belling out; and the distortion allows the brick to fall out—this defect quite aside from the cracking and scaling that curtail the casting life.

None of these difficulties is experienced with Amsco Alloy rings. The segments have room to expand and contract without warping, and the heat-resistant metal does the rest.

Their use means fewer shutdowns for repairs, which in turn mean fewer man-hours and fewer parts for maintenance; and a real gain in production volume over a given period of time.

The one of the several analyses of Amsco Alloy, grade F-10, that is most commonly used for feed end and nose rings, has excellent strength and creep resistance up to 2100° F.; and comparatively good residual ductility when cold.

Among the many applications for this metal in cement plants and comparable operations are also dampers, feed pipes, hopper extensions, lifter bars, clinker drag chains, grates and burner nozzles. Our experience, research and production facilities are at your service.

Bulletin 108, sent on request, tells the whole story.

C-710-D—A 16-segment conical feed end ring.

C-709-B—Amsco Alloy segmental nose or discharge ring.

Amsco
AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois

AMERICAN Brake Shoe COMPANY

FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO.
OFFICES IN PRINCIPAL CITIES

16750 Brown, BM-16785 Black, and BM-16786 Brown are suitable for bottle caps and closures. BM-16499 is suitable for jobs that normally require a high impact-resistant material such as BM 3510.

CONDUCTIVE FLOORING REDUCES EXPLOSION HAZARDS

Ready-mixed mastic flooring material, easily applied over present floor surfaces, is said to be an effective preventive for explosions due to static electricity in industrial plants. It is produced by Rock-Tred Corp., Chicago, Ill. The safety factor in this new flooring, known as Condurock, is said to be due to its electrically conductive quality. Heavy-duty Condurock is said to be spark-proof as well as explosion-safe. It is further claimed that the material will handle the heaviest loads regardless of wheel base.

ALGAE KILLER

One gallon of Roccal, it is said, will make 50,000 gal. of water in swimming pools free from algae. This material keeps the water clear during the entire season if small quantities are added every five to ten days. It is colorless and absolutely harmless in the concentration recommended. It will not corrode metal, attack paint or varnishes, nor affect bathing suits. Roccal is not irritating like other chemicals, according to the Inertol Co., Newark, N. J.

N-BUTYRALDOXIME

Oximes usually have been prepared in laboratories merely to identify carbonyl compounds, but *n*-butyraldoxime is now available in quantities adequate for investigation, according to National Aniline Division, Allied Chemical & Dye Corp., New York, N. Y.

Properties
(Commercial Purity)

Molecular weight	87.08
Boiling range (2% to 97%) 13 deg. C. (max.)	
Boiling point — Mid-range 154 deg. C. (max.)	150 deg. C. (min.)
Density (pure)	0.923 20 deg./4 deg.
Flash Point	58 deg. C.
Fire Point	63 deg. C.
Physical appearance	Water-white liquid

PLASTICIZER FOR SYNTHETIC RUBBERS

Synthetic rubbers, particularly GR-S, may now be plasticized with Syn-Tac. The new plasticizer is claimed to produce a fairly good degree of tackiness in this rubber. It is derived from heavy petroleum fractions, maintains good tensile strength and elongations of 3,000 to 3,300 psi. and 500 to 600 percent over the full curing range when used in amounts of about 10 parts of the GR-S in tread stocks. Tear resistance is also quite good in this rubber, and the material is reported to be effective as a dispersing agent for the other materials used in the formulations, according to the *India Rubber World*, May, 1943. Tests made on a GR-S tire which had used the material in the compound for tread, carcass, etc., showed that as regards adhesion of plies, abrasion resistance of the tread and uniformity of

cure throughout the tire; Syn-Tac might be of considerable advantage in making tires with this synthetic rubber. More complete details of the use of Syn-Tac in tire compounding and building may be obtained from The C. P. Hall Co., Akron, Ohio.

WETTING AGENT

In order to allay coal, coke, and ash dust, the powerful new wetting agent known as Kleen-Kol, has been introduced, according to the announcement of Sterling E. Norcross, Bloomfield, N. J. The concentrate, when added in minute quantities to coal-spraying water, is claimed to produce rapid dispersion of the liquid over and throughout the coal pile, "wetting" and precipitating all dust particles where water alone would be ineffective. Less than one percent moisture is added to the coal. A simple siphon attachment is available for the standard ¾ in. hose to feed the concentrate into the hose stream in the recommended dilution. Advantages are said to be: keeps boiler rooms and premises cleaner; prevents windage losses and retards oxidation in stock piles; and saves labor, maintenance, and equipment outage because of the cleaner air conditions surrounding electrical apparatus, controls, gears, bearings, etc.

Kleen-Kol contains no calcium chloride, is non-toxic, nonflammable, noncorrosive, odorless, and harmless to the skin, rubber, and composition belting.

FINISH FOR COTTON FABRIC

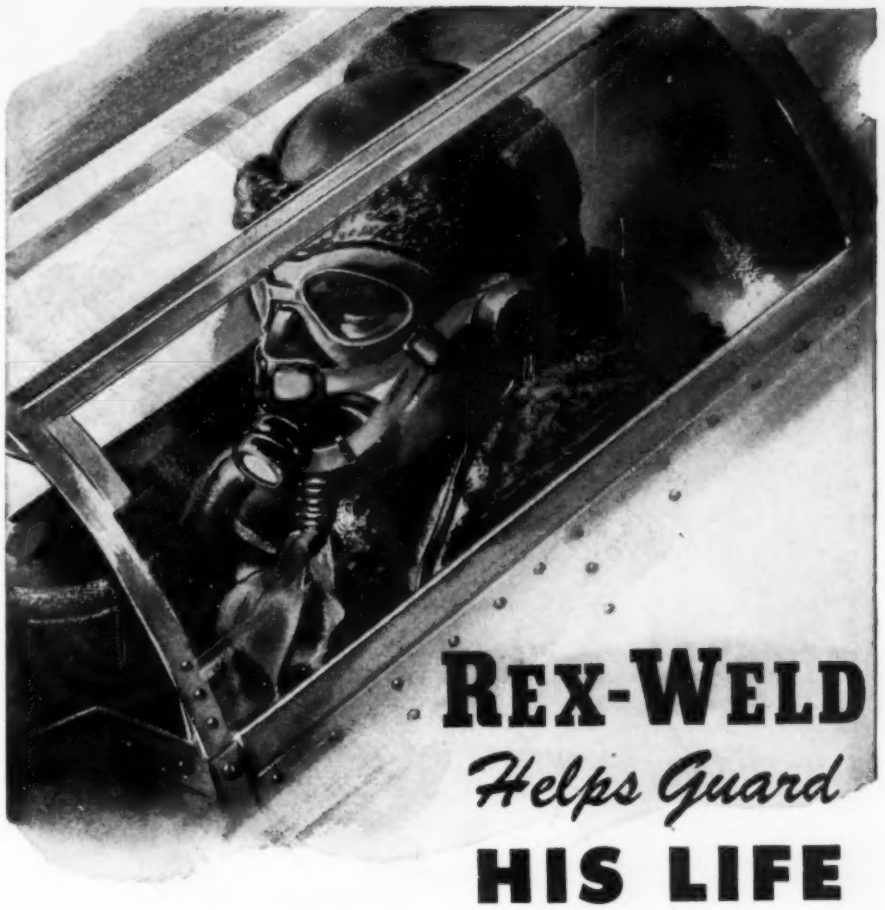
A new fire, water and weather resistant finish for cotton camouflage nets used in all climates was announced recently by the Fine Chemicals Division of E. I. du Pont de Nemours & Co., Wilmington, Del. The Army engineers have tested the new chemical finish, which is flexible in subzero weather, but which will not become sticky or support combustion at high temperatures. It is made in sand and olive drab shades, which colors are very fast to light.

RUBBER ELECTRICAL SEMI-CONDUCTOR

Announcement has recently been made by the American Steel & Wire Co., Cleveland, Ohio, of the development of a rubber compound which acts as a semi-conductor of electricity rather than as an insulating material. Company engineers said the compound would permit the manufacture of electrical cables capable of transmitting higher voltages for the operation of X-ray machines and heavy industrial equipment. The compound was developed by adding pure carbon to the hydrocarbon composition of rubber. It was described as having a high conductivity in comparison with other insulating compounds and high resistance when compared with copper.

BALSAMIC ESTERS OF RESIN

When isomeric acids are esterified in rosin with diethylene glycol the result is Flexalyn, a pale-colored, extremely tacky, translucent, semi-solid resin.



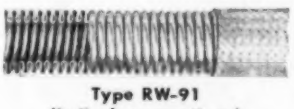
REX-WELD
Helps Guard
HIS LIFE

REX-WELD Flexible Metal Hose has met the critical test that demands only the best materials for our combat planes. More and more bombers, fighters and interceptor-pursuit ships are being Rex-Weld equipped.

REX-WELD's war service is not confined to the planes themselves. In the steel mills and munition factories, on the production and assembly lines, everywhere that war-worthy flexible connections are needed, REX-WELD is rendering vital service.

There are specific reasons for this. REX-WELD is a specially constructed flexible metal tubing. It is fabricated from strip metal by a precision autogenous welding process that produces uniform, stronger wall structure plus extreme flexibility. REX-WELD stands up under high pressures, high and low temperatures, extreme contraction and expansion. It is seep-proof to gas, water, oil, air and searching fluids.

Type RW-81
(annular corrugations)



Type RW-91
(helical corrugations)

Available in continuous lengths to 50 ft. Both Steel and Bronze. 3/16" I. D. to 4" I. D. inc. Pressures to 14,500 p.s.i. Temperatures to 1000° F.

Write for Engineering Recommendations

CHICAGO METAL HOSE CORPORATION

General Offices: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Illinois

NON-FLAMMABLE
Safe...Easy to use
ECONOMICAL

NON-SKID... Removes danger of accidents from slipping, preventing loss of man hours and possible lawsuits

FIRE-SAFE Compounded entirely of non-burnable materials

Whisk away messy, hazardous oil and grease deposits with lightning-fast CAREY Asbestos Sweeping Compound. So quick, so thorough, so *easy to use*—it's like MAGIC!

CAREY Asbestos Sweeping Compound is an improved, efficient, inexpensive, *fire-safe* compound for sweeping up oil and grease. It is the ONLY product of its kind which has been given the "Class I, Non-Combustible" rating by Underwriters' Laboratories, Inc. Highly absorptive and mildly abrasive. Used dry; nothing to add. *Non-skid*—lessens danger of accidents from slipping. Harmless to floors, hands, shoes, and clothing. Economical—use over and over until fully saturated.

This compound is excellent for soaking up acids around pickling vats, storage battery spillage, cleaning solutions, etc.

Play SAFE . . . get RESULTS . . . with CAREY Asbestos Sweeping Compound. Prompt shipments in 50-lb. bags from 48 branch warehouses. Free trial will furnish convincing proof. Samples and full information on request. Write Dept. 15.

CAREY Asbestos Sweeping Compound falls in "Class 1, Non-Combustible"—according to the Standard of Underwriters' Laboratories, Inc., for the classifications of Sweeping Compounds, in which Class 1 includes "Noncombustibles"; Class 2 "Nonflammables"; and Class 3, "Slow-Burning Mixtures."

THE PHILIP CAREY MFG. CO. LOCKLAND, CINCINNATI, OHIO
Dependable Products Since 1873
In Canada: The Philip Carey Company, Ltd. Office and Factory: Lennoxville, P. Q.

Chemically it can be referred to as diethylene glycol diabietate, although it is actually the diethylene glycol ester of a mixture of isomers of which abietic acid is the typical constituent. Flexalyn C is similar to Flexalyn in most properties but is harder since it has a higher melting point. It is the rosin ester of ethylene glycol, and thus may be considered to be ethylene glycol diabietate. The physical properties of Flexalyn and Flexalyn C fall between those of the liquid esters, Hercolyn and Abalyn, and the hard, high-melting Pentalyns. They are completely soluble in mineral and vegetable oils; in almost all solvents, except those of the alcohol type; they are compatible with a wide variety of resins, waxes, gums, asphalts, pitches; they are compatible with most water-insoluble film-formers, and miscible with water-soluble film-formers. They are produced by Hercules Powder Co., Wilmington, Del. The Flexalyns are currently offered both as solid resins and under the name Flexalyn Solution, or Flexalyn C Solution, 80 percent solids in mineral thinners. Additionally, they are available, if desired, in a stable emulsion for use where optimum application of the resin is obtained by means of a nonviscous water emulsion.

SYNTHETIC RUBBER

For specialty purposes it is said that Paracon, a new synthetic rubber, will help to meet the present requirements for rubber. This new material has been developed by the Bell Telephone Laboratories, New York, N. Y. as a byproduct of research on insulating materials. It is a polyester type similar to Norepol, but is claimed to be superior to this material in many respects. An important advantage of Paracon is that it will not compete with other synthetic rubbers for its basic raw materials, since the intermediate may be derived from a number of non-conflicting sources. In its raw state Paracon is quite plastic, but may be worked on ordinary rubber machinery. The addition of fillers that will help in making the uncompounded polymer less tacky at the start of milling is advantageous. The oxide pigments are the most satisfactory fillers. Since it has some effect on the curing rate, the use of carbon black is not advised. Vulcanization is accomplished without sulphur and accelerators, which is also in contrast to natural and other synthetic rubber compounding. The new material is unusually well adapted for use in gaskets, hose, etc,. for molding into intricate shapes, and for use in the manufacture of rubberized fabrics. In general, Paracon has a tensile strength of 1,500 to 2,500 psi., elongations of 400 to 600 percent, and a better tear resistance than is obtained in most Buna compounds. The heat resistance is claimed to be exceptional. Compounds in service of 150 deg. C. are said to outlast both natural and synthetic rubbers. Oil and gasoline resistance are also reported as very good. Aging in air and oxygen is equal to the Buna type of synthetic rubbers and is therefore superior to

natural rubber. It is inferior to natural rubber in resistance to steam, alkalis, and acids. The Resinous Products & Chemical Co., Philadelphia, Pa., and several other chemical manufacturing companies are now producnig Paracon on a semi-commercial scale.

SYNTHETIC RUBBER

As an example of what can be done by development and research on synthetic rubber, the B. F. Goodrich Co. announces that it has succeeded in making extruded parts from its Ameripol synthetic rubber which have a durometer reading of only 35—five points less hardness than any natural rubber compound the company has ever been able to successfully put through extruding machines. It has a tensile strength of 700 lb., elongation of 700 lb., and withstands cold down to 40 deg. F. below zero without cracking. Even after 48 hr. immersion at room temperature in a solution of 85 percent kerosene and 15 percent benzene, the rubber shows only a 22½ percent decrease in tensile strength and only 15 percent in elongation.

VITAMIN

Small dry tablets known as Vi⁶ contain the vitamins known to be essential to correct the vitamin deficiencies common among industrial employees, according to the manufacturer, Vitamins Industrial, Chicago, Ill. These multivitamin tablets are compounded specifically to combat nutritional deficiencies, and build industrial employees up to their utmost efficiency. They include vitamin C with vitamin A and D and the B complex, plus minerals, in balance and potency that completely fulfill the standards of the National Research Council.

DUSTING POWDER

Millions of two-ounce cans of body dusting powder for the U. S. Army—already in the packs of North African troops—will protect overseas personnel against typhus-carrying pests, it was announced recently by Grasselli Chemicals Department of the du Pont Co.

Though the powder contains some pyrethrum, an increasingly scarce standard ingredient of insecticides, according to a company official, substantial quantities are being saved by use of a du Pont developed synthetic. It was said laboratory tests proved that the replacement compound—called IN-930—increases the efficiency of the pyrethrum in the powder.

POWDER FOR WET-GRINDING OPERATIONS

Several claims are made by the Wolfe-Kote Co., Sheboygan, Wis., for its new Ever-Drest. It is a non-toxic, non-irritating white powder to be added to the water used in wet-grinding operations. It promises to prevent carbonization of grinding wheels, to keep them open, to prolong their lives, and to promote high grinding efficiency.

SIMPLIFY

PIPE LINE MAINTENANCE

Babbitt *Plastic* Sealants

FOR EVERY SEALING JOB

BEARING CRANKCASES AND FLANGES

PIPE FLANGES AND BOLTS

GROUND PIPE COUPLINGS

VALVE SEAT INSERTS

LINE Y PLUGS

These permanently workable joint and gasket compounds save Time, Labor, Material and Money

Babbitt Plastic Sealants simplify the job of keeping production rolling by speeding pipe repairs, enabling fewer men to handle the maintenance work.

Time and Labor saved: Babbitt Sealants are ready-mixed. They make tight yet remain *permanently workable.* Even long-standing unions take down readily. Readjustment of pipe lines is easy.

Money and Material saved: With Babbitt Sealants no costly time or material is wasted cutting and hammering "cemented" joints. Pipe and fittings disassemble easily, undamaged and in condition for re-use.

Babbitt Plastic Sealants are widely used for extremes in temperature, pressure and vibration, and to seal against water, steam, brine, alcohols, oils, gasolines, gases, commercial acids and other chemicals. Each Babbitt Sealant handles a wide range of application, further simplifying maintenance. Try Babbitt Sealants for better sealing.

Send for "The Story of Sealants"—informative, 12-page book describing Babbitt Sealants and their applications

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Sealing Specialists for Industry

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Babbitt
ENGINEERED TO EXACT STANDARDS
Sealants

TRY *this versatile blending agent*

2-METHYL-2, 4-PENTANEDIOL

Substances miscible with

2-METHYL-2, 4-PENTANEDIOL

Water	Acetone
Castor oil	Diacetone
Petroleum naphtha (light)	*O*-Dichlorobenzene
Benzene	Ethylene dichloride
Toluene	Chloroform
Methanol	Carbon tetrachloride
Ethanol	Carbon disulfide
Isopropanol	Ethyl ether
Butanol	n-Butyl ether
Glycerine	Mesityl oxide
Aminomethylpropanol	1,3-Dioxan
Triethylamine	Ethyl acetate
Nitroparaffins	Butyl acetate

. . . miscible with a wide variety of liquids

2-Methyl-2,4-pentanediol is completely miscible with such dissimilar substances as water, petroleum naphtha, coal tar hydrocarbons, castor oil, and the common alcohols, esters, and ketones. The limited quantity now available is proving useful in numerous applications as a coupling or stabilizing agent, as a plasticizer, and as a mild humectant.

"2-2-4" may be used in such preparations as cleaning and polishing compounds, textile "conditioning" and lubricating oils, printer's ink, and oil emulsions. It also functions as a glycerine substitute for various industrial purposes.

A special grade of 2-2-4 . . . recommended for use in products where minimum odor is important . . . is obtainable at a slight premium over the regular grade. When requesting samples please specify which grade is desired.

PROPERTIES

Molecular Weight: 118.17
Specific Gravity: 0.922 at 20°/20°C.
Distillation Range: 192°C. to 199°C. at 760 mm of Mercury
Refractive Index: 1.4282 at 20°C.
Melting Point: Becomes semi-solid at –40°C. with no crystal formation
Flash Point: 94°C. (201.2°F.)
Vapor Pressure:

Temperature °C.	Vapor Pressure mm of Hg
90	8.5
100	14.3
120	41.3
140	104.1
150	159.3
160	237.7
180	494.7
190	692.1

Saybolt Universal Viscosity: 75°F./2 mins. 51 secs.
32°F./17 mins. 9 secs.

COMMERCIAL SOLVENTS
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PERSONALITIES

William M. Rand

George W. Burpee

John J. Grebe

✦WILLIAM M. RAND, vice president of Monsanto Chemical Co. and general manager of the Merrimac Division, was elected to the executive committee of the company.

✦DANIEL S. DINSMOOR, assistant general manager of the Organic Chemicals Division of Monsanto, has been elected a vice president and will succeed Mr. Rand as general manager of the Merrimac Division.

✦JULIUS A. BERNINGHAUS, general manager of the Organic Chemicals Division of Monsanto, will retire November 1.

✦OSBORNE BEZANSON, vice president of Monsanto and general manager of the Texas Division, will succeed Mr. Berninghaus as general manager of the Organic Chemicals Division. The Texas Division will become a part of the Organic Chemicals Division.

✦JAMES E. PEW has been appointed assistant director of the Division of Natural Gas and Natural Gasoline in the Petroleum Administration for War. He succeeds Paul M. Raigorodsky, who resigned in June. Succeeding Mr. Pew as chief of the Natural Gasoline Section of the division is Charles E. Webber. The new assistant director has had 20 years' experience in the natural gas and natural gasoline industry. Born in Pittsburgh, Pa., in 1900, he was educated in the public schools of that city and then attended Cornell University and Massachusetts Institute of Technology. Mr. Webber was born in Stillwater, Okla., and was educated at Pittsburgh, Pa., and Baton Rouge, La. He received an M.A. in chemical engineering from the Louisiana State University in 1934. He was employed by Humble Oil and Refining Co., from 1934 until June, 1943, when he joined the PAW as assistant to Mr. Pew in the natural gasoline section.

✦GEORGE W. BURPEE has been elected president of General Aniline & Film Corp., New York. He succeeds Robert E. McConnell, resigned. For many years he was a member of the engineering firm of Coverdale & Colpitts.

✦W. F. LAMOREAUX, formerly general manager of Ducktown Iron & Chemical Co., Isabella, Tenn., is now director of research for Meehanite Metal Corp., New Rochelle, N. Y.

✦ALVIN S. WEISS has resigned as research chemist for Schenley Research Institute to accept a position as research and development engineer with Knickerbocker Development Corp., Belleville, N. J.

✦W. O. FROHRING, newly-elected director of American Home Products Corp., has been appointed special technical consultant of the corporation and its subsidiaries. In his new post, Mr. Frohring will concentrate on research and development work in connection with new products to be introduced when the war ends.

✦DAVID MACGREGOR has been appointed chief engineer of the Edward Valve & Mfg. Co., Inc., East Chicago, Ind., with which company he has been associated in various engineering capacities since 1925. Mr. MacGregor was educated in Scotland and took additional engineering work at the Illinois Institute of Technology and Purdue University.

✦E. L. FEININGER is manager of the new resin and insulation materials division of appliance and merchandise department of General Electric Co. His headquarters will be at Schenectady. He has announced the appointment of C. K. Mead as sales manager, C. S. Ferguson as engineer, and H. K. Collins as superintendent.

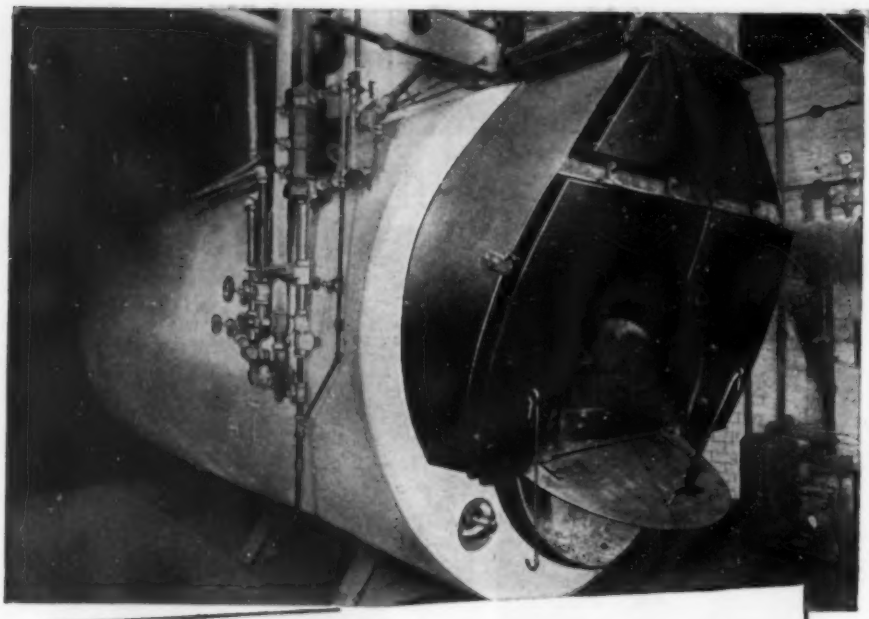
✦JOHN J. GREBE, director, Physical Research Laboratory, Dow Chemical Co., Midland, Mich., has been elected to receive the Chemical Industry Medal for 1943. This award is for valuable application of chemical research to industry. The medal will be awarded at a meeting of the American Section of the Society to be held in New York City in November. In electing Dr. Grebe to receive the medal the committee cited his contribution in the solution of some of the very difficult problems connected with the automatic control of chemical reactions, particularly with reference to the anticipatory control necessary to the reactions. His success in this field has given him a unique standing.

✦EDGAR C. BRANDT has been elected a member of the board and vice-president in charge of manufacturing of the Elliott Co., Jeannette, Pa. Mr. Brandt joined the company after 38 years with Westinghouse Electric & Mfg. Co.

✦J. W. PECKHAM has been appointed manager of development and design engineering department for the Bristol Co., Waterbury, Conn. He will make his headquarters at the general offices of the company in Waterbury.

✦IRVING MERDINGER, a graduate of New York University, and formerly with the U. S. Rubber Co., has joined the research staff of Foster D. Snell, Inc., Brooklyn, N. Y. Other additions to the staff are Madlyn M. Sheldrick of Brooklyn College and Asher Wollison of the College of the City of New York.

✦SAM TOUR is now operating the metallurgical laboratories that were established by him during the 14 years he was vice-president and chemical and metallurgical engineer in charge of engineering departments of Lucius Pitkin, Inc., as the laboratories of Sam Tour & Co. The laboratories are located in



125-hp. Scotch Marine Boiler in which steam pressure is maintained at 125 lbs. at a temperature of 350° F. Heat losses were substantially reduced by application of B-H *Black* Rock-Wool Blankets 2" thick and finished with ½" coat of B-H No. 1 Insulating Cement.

FOR INSULATING EFFICIENCY

AND LOW-COST APPLICATION

YOU CAN'T BEAT

B·H ROCK·WOOL BLANKETS

Baldwin-Hill Blankets are made by felting B-H *Black* Rock-Wool into large flat sheets between 4 different styles of metal fabrics. This B-H *Black* Rock-Wool is effective up to 1200° F. and is moisture-resistant. Standard blanket sizes of 2'x4' or 2'x8' make possible applications to large areas at minimal cost. Being flexible, they do not break in handling and easily conform to curved surfaces.

If a cement finish is desired, style 2A Blanket includes expanded metal lath making a good surface for keying the cement. This eliminates the necessity of applying a metal fabric to hold the cement as must be done in covering other types of insulation.

Send for catalog with full information and a generous sample of B-H Rock-Wool Blanket.

BALDWIN-HILL INSULATIONS

BALDWIN-HILL COMPANY

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New York. Mr. Tour was graduated in chemical engineering at the University of Colorado and won a Master of Science degree at the University of Michigan. He also served on the faculty there, installed a laboratory and taught the course in road asphalts and bitumens.

George A. Benington

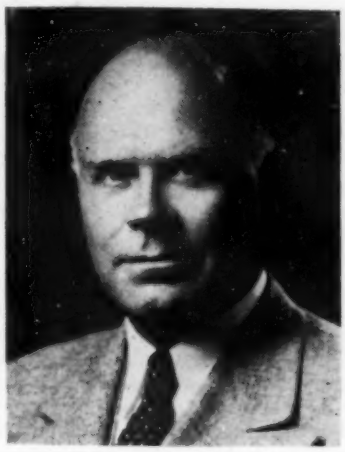
✦ GEORGE A. BENINGTON has been elected president of Mutual Chemical Co. of America, and Dr. Herbert M. Kaufman has been elected chairman of the board. Dr. Kaufman was formerly president of the firm and Mr. Benington was formerly executive vice-president.

Julian M. Avery

✦ JULIAN M. AVERY has been elected vice-president in charge of research and development of Diamond Alkali Co. Mr. Avery has been director of the research and development laboratory at Diamond's main plant at Painesville, Ohio, since joining the company in 1941. Previously he had been with Arthur D. Little, Inc., Cambridge, Mass. Earlier he had spent a number of years with Union Carbide & Carbon Corp.

✦ JOHN H. LUTZ, former assistant professor of chemical engineering at Massachusetts Institute of Technology, has been appointed as research staff project leader in charge of packaging research at the Central Laboratories of General Foods Corp., Hoboken, N. J. At the same laboratories Millard O. Ricker,

formerly employed by Trojan Powder Co., has joined the research staff as project leader in the engineering research section. Another former research project leader, Dr. Harold S. Levenson, has been made a division head in the physical chemistry section of Central Laboratories.



Roger H. Lueck

✦ ROGER H. LUECK, of Oak Park, Ill., director of research of the American Can Co., was awarded the honorary degree of Doctor of Science for outstanding contributions in science and industry during the commencement program at Carroll College, Waukesha, Wis. A former instructor in chemistry at the University of Wisconsin, Dr. Lueck has been associated with the American Can Co., since 1922.

Howard L. Tiger

✦ HOWARD L. TIGER and H. W. Foulds, vice-presidents of the Permutit Co., New York, have been made directors of the company. Mr. Tiger, the company's director of research, has been with Permutit since 1918. Mr. Foulds joined Permutit in 1935. He was formerly vice-president of Servel, Inc.

✦ JAMES BROWNSON is organizing a new research laboratory at the Tarentum Paper Mill Co., Tarentum, Pa.

✦ RONALD Q. SMITH, Edouard R. L. Doty and James E. Reilly, majors in the Chem-

There's an

R-S DISTRIBUTOR

As Near as Your

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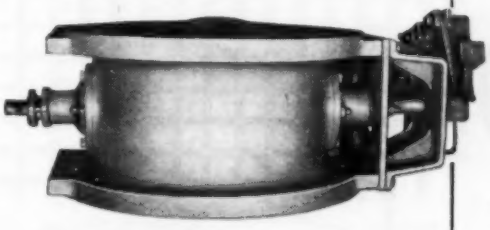
Above: 15-lb Wafer Type (Narrow face-to-face construction). *Below:* 125-lb valve equipped with control cylinder. Double end stuffing box eliminates end thrust.



These R-S Distributors are valve specialists. They are experienced with the solution of problems encountered in the control and shut-off of air, gas, steam, liquids and semi-solids. Familiar as they are with the application of valves to high and low pressures, temperatures and volumes, they can frequently make suggestions that will simplify a valve installation and reduce costs.

Naturally, these local representatives are throughly familiar with the R-S development of special metals for resistance against heat, abrasion and corrosion.

Get acquainted. These valve experts are good men to know well.

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15 to 900 psi

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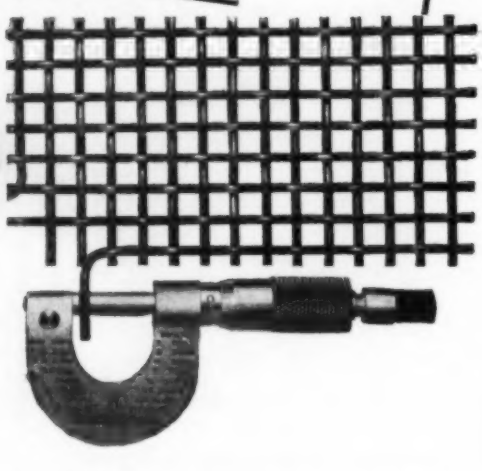
R-S Streamlined BUTTERFLY VALVES

Skill in Warping a Loom Beam is reflected in Precision Woven Wire Cloth

NEWARK for ACCURACY



WORKING with the best quality wire it is possible to buy, we rely upon the most reliable of skills—the skill of the human mind and hand—to get all Newark Wire Cloth off to a good start.

Warping the Loom Beam is the key to the precision to be found in woven wire cloth. Without the utmost skill, no cloth can be fully accurate in its mesh.

In our sixty odd years of service to industry, we have always adhered to a policy of turning out "precision-made" woven cloth because cloth to be serviceable at all must be accurate.

NEWARK WIRE CLOTH COMPANY

350 Verona Avenue, Newark, N. J.

8-NWC-1

ical Warfare Service, have been awarded the Legion of Merit for meritorious conduct in the Hawaiian area.

✦ FRED W. FRALEY has been appointed vice-president and director of sales of Diamond Alkali Co. A graduate chemical engineer, Mr. Fraley has been associated with Diamond for the past 15 years.

✦ E. L. LUACES has been elected president of the Chemical Developments Corp., Dayton, Ohio. Mr. Luaces is on the board of directors of the Commonwealth Engineering Co. of Ohio, and several other corporations, and is also associated with the law firm of Toulmin & Toulmin in Dayton.

✦ J. B. PEAKE, formerly New York district sales manager of Mathieson Alkali Works, New York, has been appointed to the post of assistant general manager of sales. In his new capacity Mr. Peake will be assistant to D. W. Drummond, general manager of sales. Born in Norfolk, Va., in 1894, Mr. Peake attended Washington and Lee University, and during World War I was attached to the 29th Air Squadron as aerial observer. He joined the New York office of Mathieson in 1920.

✦ WILLIAM L. MCGRATH is a recent addition to the engineering staff at Carrier Corp., Syracuse, N. Y.

✦ WARREN E. EMLEY, chief of the division of the National Bureau of Standards dealing with rubber, leather, textiles, paper, plastics and related materials will retire October 1. He will be succeeded as division chief by Dr. Archibald T. MacPherson.

OBITUARIES

✦ SAMUEL REID RUSSELL, of the explosives department, E. I. du Pont de Nemours & Co., died suddenly July 8 at a hotel in Easton, Pa. His age was 63 years.

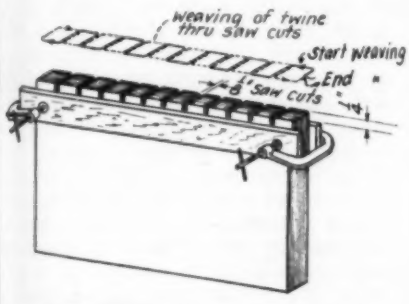
✦ HARRY B. MELLER, research engineer and pioneer in smoke control work, died at Pittsburgh, June 27, at the age of 65. He had been in ill health for several years. Dr. Meller headed an air pollution investigation which has been conducted at Mellon Institute since 1923. When the Industrial Hygiene Foundation of America was founded in 1925 he became its director. Dr. Meller resigned last September because of poor health.

✦ EARLE D. PARKER, vice-president and general works manager of Barber-Colman Co., died June 12, following a heart attack on a farm near Durand. He was 63 years old.

✦ GOULD G. RHEUBY, 74 years old, who had retired as vice president, director and member of finance committee of Hercules Powder Co. in January, died on July 28 at his home.

FROM THE LOG OF EXPERIENCE

BACK FILES OF TECHNICAL MAGAZINES are important tools of the engineer and are useful provided they are bound. Since these books are not used much nor disrespectfully, a home-made binding is satisfactory and thrifty, though not ornamental. The job can be done by the office boy. The method as illustrated was contributed by Fred Buffum (MIT '00) while a draftsman at the Cambria Steel Co. in 1900, at a time when frugality was the order of the day.


Weaving of twine thru saw cuts
Start weaving
End
1/8" Saw cuts
1st Clamp magazines as shown and sandpaper back smooth
2nd Make saw cuts about 1/8" deep and 1" apart
3rd Weave twine thru saw cuts
4th Paint back with Le Pages Glue

D GEORGE ROBINSON, the colored ncle Tom who served as porter around e works for a quarter of a century, gave notice a few years ago that he proposed to resign and retire from his arduous duties. His last day was spent in shaking hands with everyone in the plant from the general manager to the office boys. For 25 years he had appeared with unvarying regularity at 5 A. M. One morning the belt line freight blocked his path in front of the refinery. Laboriously he crawled into an open box car and, just as he was about to lower himself through the opposite door, the train started and George followed along with his lunch bag almost to Trenton. No word could be obtained from his home. The story got around that poor old George had died, and someone started a collection for the purchase of a wreath. The Supt. assigned a successor. The next day George returned, removed the crepe from his closet door and chased his successor. The windows in his cubicle in the cellar were dark with the grime of time. He said he washed them 10 years ago, but "'taint no use." His wife served as matron at the Reading station during all the years that George worked at the refinery. She administered the savings of frugal George along with her own, and he looked forward with contentment to a comfortable retirement in the little Virginia cabin where he was born shortly after the Civil War. However, when his wife died, he discovered that the savings account and other property were recorded under her

Dan Gutleben, Engineer

ownership and had been devised to a willful daughter. That left old George in the cold and he joined household with an aged sister in Washington.

WHEN THE OLD MAN WALKS through the plant and observes all the complexity of apparatus he marvels, "how on earth do all of these things run!" The reason, of course, is that there are some faithful Fritz Heilmans on the job. They frequently take a hazardous chance, but the guardian angel watches over them. Fritz started at the Long Island refinery in '97 and retired at the end of '42. His job was trouble shooting to anticipate outage. On an occasion a 20" rubber belt, carrying the raw sugar elevator buckets, parted and dropped into the boot. The two ends were pulled together by means of the usual clamps and two chain blocks preparatory to making the splice. Fritz crawled into the elevator casing near the boot in order to make sure that between there and the splice there were no twists in the belt. He could have sent a helper or followed some less effective method of inspection that would not have exposed him to the hazard. Anyhow Fritz used the buckets for a Jacob's ladder, while his back scraped the casing and his stomach was massaging the buckets. Suddenly the belt began to move. Some numskull had started the wrong motor! The belt did not move more than 50 ft. by the chronometer, but this was long enough for many unfinished jobs to pass in review before Fritz's mind. The thoughts moved fast when the termination of his biograph suddenly stared him in the face. When the unfinished splice with the clamps and chain blocks reached the top the belt stopped. Fritz holed out at the head and certified that the belt was O. K. for splicing.

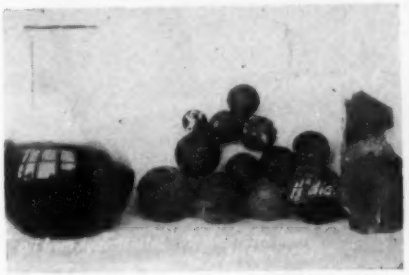
AN OMAHA SHOE STORE displays a bit of wisdom above its entrance, to wit:

"There never was a product made,
This truth we must confess,
But what some bird could make it worse
And sell his junk for less."

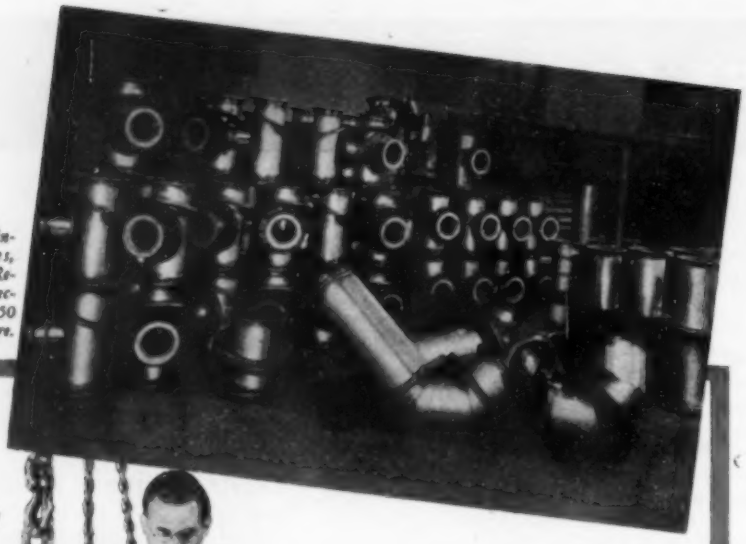
NEAR THE GREAT WEST-COAST metropolis, a group of astute men, trained both in finance and engineering, foresaw the "benefits" of the establishment of a new race track. For a readily accessible site they selected a tule marsh where the ebb and flow of the tide had for many years attracted swarms of gulls by floating in delectable subsistance needs. The filling of the tide land was economically accomplished because a near-by hydraulic dredge needed a dump. In due time a magnificent track and grandstand were constructed and luxuriously appointed. Then followed the grand opening and Society was there in all its glory—and so were the sea gulls! The finances and mechanics had been subjected to mathematical analysis, but the sea gulls did not behave mathematically. The customers refused to carry umbrellas and so the investment failed because of the lack of an ornithological consultant.

ANYBODY CAN RUN A BOILER if the feed water is properly conditioned and free of scale-forming matter. The practice of returning a portion of the continuous blow-down to the sedimentation tank of the softener system saved chemicals and worked satisfactorily until the chemist in his inexperience applied his urge to improve. He added a tannin compound which promotes flocculency in the precipitate and inhibits embrittlement through absorption of oxygen (like pyrogallol). The tannin was added to the treated water after the softener because its acidity would otherwise neutralize the caustic soda and disodium phosphate used for precipitating the raw water hardness.

Without notice three tubes in the bottom of the furnace failed. Total outage 12 hours! The picture shows what was found in the bottom headers.



Hard scale had been formed and when the flakes loosened they became tacky with oil and agglomerated into balls. The chemist knew that tannin could not be added at the settler, but he forgot that he was doing that very thing by way of the return of the continuous blow-down. The tube failure also called attention to improper maintenance of the oil removal apparatus. The condensates from the exhaust steam contained 8 ppm of oil. This was immediately reduced to 1 ppm by repairing the steam separator and cleaning out the traps. Charlie Joos, Cochran's efficient "water doctor," reminisced that his first encounter with tannin-infested water occurred in Minnesota where he installed a hot process lime-soda softener. The raw water contained 2 grains of hardness while the treated water had 4! He learned that when tannin is present in the raw water supply, as sometimes occurs in the New Jersey forest country or in the Pennsylvania coal fields, it must be removed before the softening agents are added.



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Tees, elbows, crosses and special fittings made to your specifications can be furnished. In addition, we manufacture stainless steel and alloy tubing 4" or larger in diameter and prefabricated assemblies in all diameters; wall thicknesses from #18 gauge to ¼".

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TANKS • KETTLES • CONDENSERS • AGITATORS • EVAPORATORS • PANS
VATS • CYLINDERS • ALLOY PIPING

IN 1898 A BEET SUGAR house was built at St. Louis Park, Minn., just above the Minnehaha Falls. The building once housed the famous Esterly Harvesting machinery factory whose product was known far and wide among the northwestern farmers for its superior and ingenious construction. The equally well-known firm of Walter A. Wood entered the territory with designs which were alleged to infringe on the Esterly patents. The two joined in legal combat over patent priorities and battled until their reserves were exhausted and both shops collapsed. The Esterly Shop, though built of wood and ill suited for the function of a sugar works, was taken over under the urge of promoter Fred Hinze in '98, assisted by his friend Wagner, well known for the quality of the beer that he brewed. The design of the plant was furnished by E. H. Dyer & Co., of Cleveland with "H. P." in charge of the engineering, as well as subsequent operations. Kilby furnished the equipment and sent structural expert Jacob Neuert to the site to put the old wooden building into shape to receive the machinery. Fred Hinze added color to the operating procedure and when opportunity permitted "accidentally" tried "H. P.'s" new automatic diffusion battery discharging door while "H. P." was in the pit, thereby dousing him in four tons of pulp!

The first crop, having been harvested and stored before the completion of the factory, froze solid. The slices agglomerated in the diffusion battery into lumps of ice. After six years of struggle, the distress of waging a losing fight was providentially relieved when a fire mopped up the monstrosity in 1905. The battery and evaporators were picked up by G. S. Dyer, and installed at Visalia, Calif., and the rest went into the furnace. The water supply for the factory came from a row of 28 wells operated by air lifts, and the factory waste flowed over the Minnehaha Falls. On one occasion, during a dry spell, the sewage furnished the water that produced the grandeur of the Falls. If the sugar house had been there 50 years earlier, Longfellow's immortal "Laughing Water" might have been given an ambrosial quality.

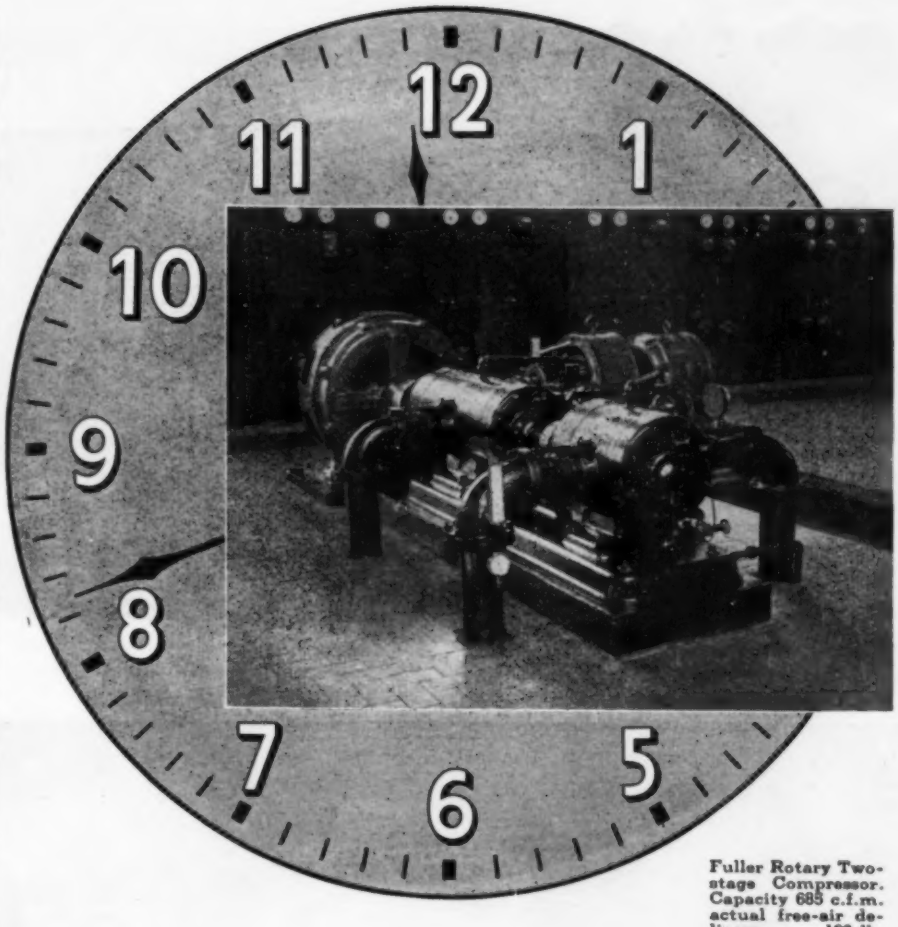
THE HUB of the beet sugar industry in Michigan was established in Bay City around 1900 when the timber tycoons switched from trees to beets. The famous Captains Boutell, Cranage and Davidson, possessing superior business acumen, extracted wealth from timber lands. They built fleets of freighters out of pine for traffic between Chicago and Buffalo. When the land was logged off, they turned to beets to recoup productivity. About 1900 the stumpage had for the most part been liquidated, leaving behind accumulations of capital, stumpy terrain, mounds of smoking sawdust and more or less idle saw mills. The lumber men first turned ship builders and then real estate men. Captain Davidson did not run away from a fight or a law suit but he could accept a loss like a sport. His shrewdness and

acquisitive skill begot envy and jealousy and frequently inspired in some warped mind the fabrication of an anecdote which reflected prejudice rather than fact. His bank once paid a disputed balance of $21,000 on the Mt. Pleasant sugar house contract with a sheaf of large-denomination bills. Fantastically it was alleged that the teller pushed a basketful of wrinkled one-dollar bills through the wicket with the remark, "Here they are: 21,000 of them. Count them yourself!"

IN THE PIONEER DAYS of beet sugar manufacture, many disturbances arose, the causes of which were mysterious. It relieved the mind to lay these things to the chemist because the problem frequently came within his sphere, and anyway, he was in the minority. On one occasion the lime mill was taken apart, cleaned and reassembled. It still refused to perform properly, and while the boys were standing about in speculation of the causes, one wiseacre chirped up with the proposition that nothing had been changed. "It musta been the chemist." Since then chemists have grown in importance and esteem. Every house has at least one who is generally known as "Doc." He is usually a much traveled man saturated with enthusiasm and experience, but he must also be equipped with a vivid imagination to substitute where experience lacks. In order to inspire acceptance of his ideas for some departure from the orthodox procedures, he must remember that he tried it out in South America or some other distant place far enough removed to command respect.

THE STAFF ENGINEER of a sugar manufacturing company in Michigan is afflicted with a slight deficiency in his hearing which does not affect the high quality of his performance, but the "Old Man" was inconvenienced because of extra effort required when he desired some engineering advice. And so the "Old Man" made the suggestion that the engineer provide himself with a mechanical hearing aid. There was procrastination till the contract for the engineering service expired. The "Old Man" sent two contracts to the engineer's desk, one being a duplicate of the old one and the second being likewise a duplicate, but naming a higher salary and adding the stipulation that the party of the second part install a hearing aid. The engineer signed the second one and conducted himself accordingly.

THE FIRST BLACK-OUT that was announced by the blowing of the city sirens occurred on a week-end when the refinery was idle, so the only formality required was the pulling of the lighting switches. This threw the works into darkness, but the warehouse and garage lights continued to glow dimly. The "Wizard" was on duty and promptly solved the mystery. He found that the electric truck batteries were on charge, and when the main feeders were cut off, the batteries fed current back through the lines.



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Get acquainted with Fullers. Write for new Bulletin C-5 . . . it's yours for the asking.

C-76A

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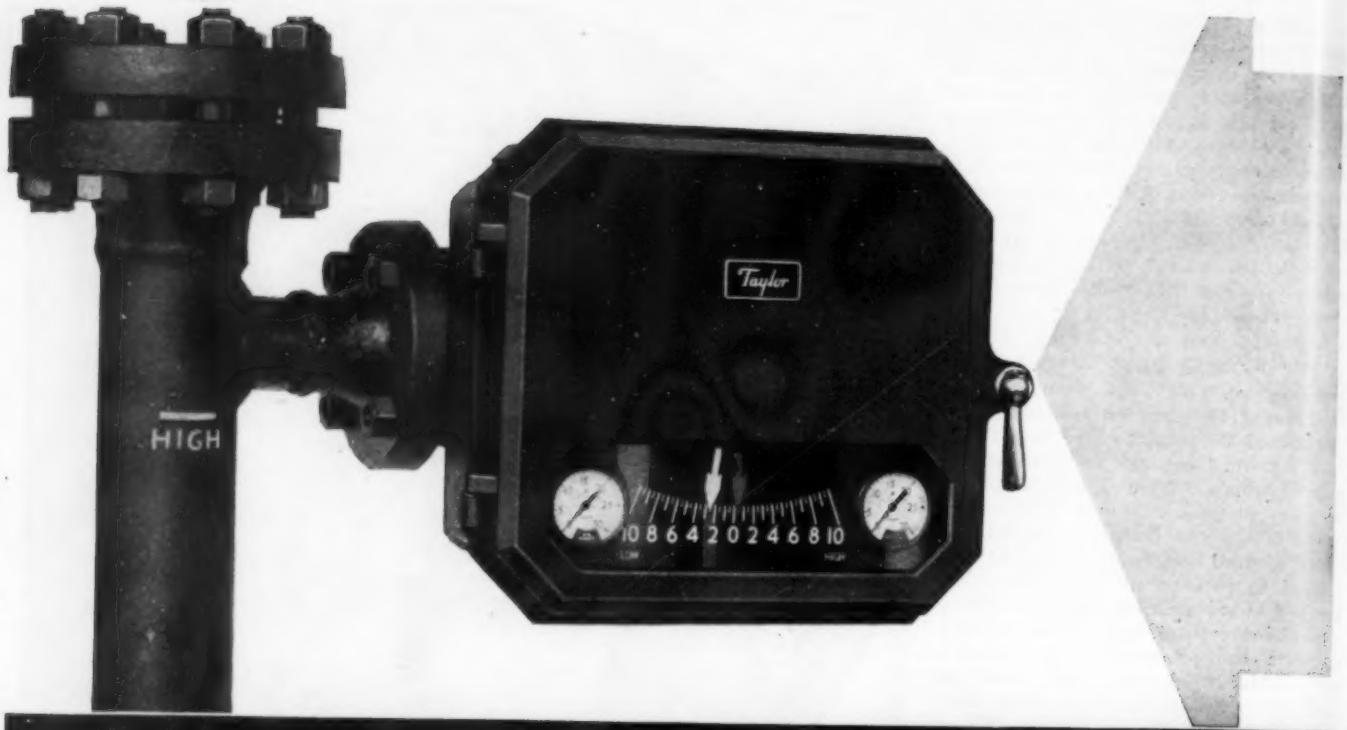

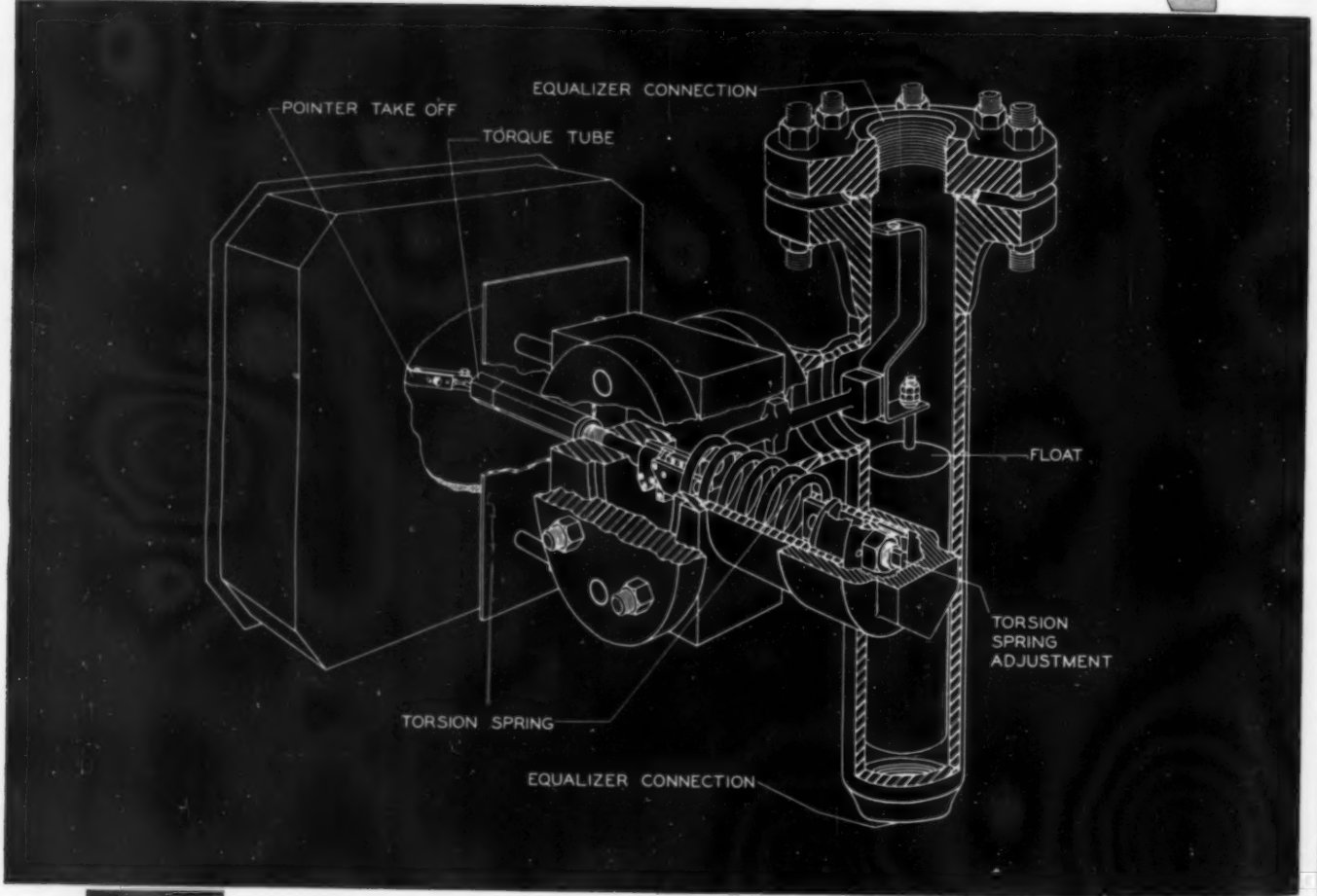

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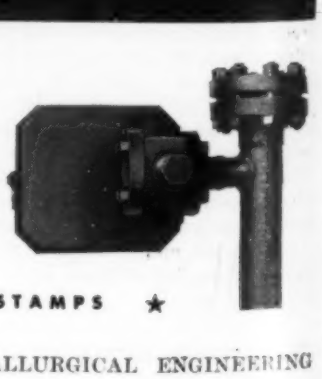
No friction or wear—no lubrication required in this new Taylor Level-Buoy. Level measurement is carried from the float through a torque tube—to a Taylor Fulscope Controller which gives you not only control but *direct indication!* Torque tube and tension spring are both readily accessible as shown by photo at right.



★ KEEP ON BUYING U. S. WAR BONDS AND STAMPS ★

MEETINGS AND CONVENTIONS

AMERICAN WELDING SOCIETY TO MEET IN CHICAGO

THE TWENTY-FOURTH annual meeting of the American Welding Society will be held in Chicago, Ill., the week of October 18, it has just been announced. Headquarters of the meeting will be at the Hotel Morrison.

Some of the technical papers of interest to chemical and metallurgical engineers are as follows: "Electronic Control of Gas-Cutting Machines", by R. D. McComb, General Electric Co.; "Flash Welding of Alloy Steels", by C. M. Manzer, General Electric Co.; "Proven Applications of Flame Hardening", by Edward Gruber, Wheeling Steel Corp.; "Flash Welding of Nickel and High-Nickel Alloys", by W. F. Hess and A. Muller, Rensselaer Polytechnic Institute; "Modern Methods for Welding Copper and Its Alloys", by J. J. Vreeland, Chase Brass & Copper Co.; "Maintenance of Tools and Equipment", by T. B. Jefferson, The Welding Engineer. There will also be a General Electric film on atomic hydrogen welding.

NATIONAL ASSOCIATION OF FOREMEN HOLDS RADIO CONVENTION

THE FIRST national convention ever held by radio will be staged in September over a nationwide network by the National Association of Foremen, it was recently announced by Frank H. Irelan, vice president of the N.A.F.

In addition, the convention may also be the briefest in history, as the network program will be limited to one hour, with speakers of national prominence discussing questions of interest to American industry. Throughout the country member clubs of the association will hold local meetings at which they will listen to the national broadcast and then proceed with localized discussions by association members and by other industrial leaders.

ELECTROCHEMICAL SOCIETY PLANS PROGRAM

PROGRAM PLANS for the next meeting of the Electrochemical Society, to be held in New York, October 13-16, are already under way. The following manuscripts for the New York meeting are in the hands of the printer: "Electrolytic Reduction of Trinitro Aromatic Compounds to Triamines by Use of a Carrier Catalyst", by Lewis and Brown of Indiana University; "Electrolytic Reduction of p-Nitrobenzoic Acid to p-Aminobenzoic Acid", by Brown and Ravenscroft of Indiana University; "Corrosion Resistance of Silver-Plated Steel; Phosphating Steel Before Plating", by P. J. Lo Presti of Rochester; "Electrolytic Reduction of Cinnamic Acid", by Wilson and Wilson of London; "Iron Plating", by W. B. Stoddard of Champion Paper and Fibre Co.

In addition to the above there have been 16 more papers received at the Secretary's office to be presented at the meeting. All those interested in submitting papers for the Electro-Organic session are asked to send their manuscripts at once to Dr. H. Jermain Creighton, Swarthmore College, Swarthmore, Pa.

A.S.T.M. HAS SUCCESSFUL MEETING IN PITTSBURGH

WITH A REGISTERED attendance of 1,452 and 245 technical committee meetings at each of which there was excellent attendance of members, and an interesting technical program of papers and reports in the fields of both metals and non-metals, the 46th annual meeting of the American Society for Testing Materials held in Pittsburgh, June 28-July 1 was outstanding. The attendance was the third highest ever recorded at a meeting.

At the Society's general session, the new president for 1943, Dean Harvey, materials engineer, Westinghouse Electric & Mfg. Co., was introduced as was also the vice president, J. R. Townsend, materials standards engineer, Bell Telephone Laboratories, Inc., and the following new members of the executive committee: T. A. Boyd, Research Laboratories, General Motors Corp.; W. H. Finkelday, Singmaster and Breyer; E. W. McMullen, director of research, The Eagle-Picher Lead Co.; E. O. Rhodes, technical director, Koppers Co., and F. G. Tatnall, manager, Testing Equipment Department, Baldwin-Southwark Division, Baldwin Locomotive Works.

At this session the retiring president, H. J. Ball, an authority in the textile field, discussed the relation of A.S.T.M. to the textile industry, while A. H. Phelps, vice president, Westinghouse Electric & Mfg. Co., spoke on maintaining quality under wartime conditions. Walter Bonsack, chief metallurgist and director of research laboratories, National Smelting Co. received the 1943 award of the Charles B. Dudley Medal for his outstanding research paper published during the year. Another notable feature of the meeting was the 18th Edgar Marburg Lecture, delivered by L. J. Markwardt, chief, Division of Timber Mechanics, Forest Products Laboratory, Madison, Wis.

T.A.P.P.I. TO HOLD TECHNICAL SERVICE CONFERENCE

THE TECHNICAL Association of the Pulp and Paper Industry will sponsor a technical service conference for the benefit of all paper manufacturers and paper users engaged directly in the war effort. This will replace the fall meeting and will be held at the Palmer House, Chicago, Ill., September 21-24.

In the past, all meetings of this organization have dealt largely with technical subjects that featured the industry in the region where the meeting was held. This year, however, the meeting will be devoted to the discussion of the all-important job of winning the war. It is therefore a sponsored conference with all branches of the industry invited to participate. More than 20,000 sq.ft. of exhibit space at the Palmer House will be utilized by the Army and Navy to show how paper and containers are used by these services. In attendance, and ready to discuss their problems and requirements with all interested parties, will be a large group of officers of the Ordnance Dept., Engineers Corps, Signal Corps, Quartermaster Corps, Chemical Warfare Service, Medical Department and the various branches of the Navy.

AMERICAN CHEMICAL SOCIETY PLANS MEETING IN PITTSBURGH

CENTRAL THEME of the 106th meeting of the American Chemical Society in Pittsburgh, Pa. will be "The Catalysis of War Chemistry." The meeting will be held September 6-10 with headquarters at the Hotel William Penn.

"Manpower" will be the subject of a three day symposium at which industrial leaders will discuss measures to over-

CALENDAR

SEPT. 6-10	American Chemical Society, 106th Meeting, Hotel William Penn, Pittsburgh, Pa.
SEPT. 21-24	Technical Association of the Pulp & Paper Industry, Wartime Service Conference, Palmer House, Chicago, Ill.
OCT. 13-16	The Electrochemical Society, Hotel Pennsylvania, New York, N. Y.
NOV. 14-16	American Institute of Chemical Engineers, 36th annual meeting, Pittsburgh, Pa.
DEC. 6-11	Nineteenth Exposition of Chemical Industries, Madison Square Garden, New York, N. Y.

"Yes Sir, this wrench tops them all"

A reversible ratchet wrench that's

STURDY . . . built strong for rough use

SIMPLE . . . fewest possible number of working parts

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SAFE . . . positive action; can't slip off the nut

The FAVORITE wrench operates in narrow spaces . . . can be used over long studs . . . and has heads that fit two different sizes of nuts. Made with three sizes of handles, with heads to fit all U. S. Standard bolt nuts to 1½ in.

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come shortages of training men for essential jobs. Other symposia will deal with the subjects of plastics, food shortages, unit processes, vitamins, industrial hygiene, and research management of small laboratories.

SELECTIONS FROM CONVENTION PAPERS

Chemical Engineering and Social Education 174
Recent Developments in Pressure Cooked Plywood 174
Countercurrent Absorption in Non-Aqueous Systems 175
Production of Waxy Corn and Waxy Sorghum Starches 175
Laws Governing Growth of Films on Metals 176
A New Potent Organic Fungicide 177
Civilian Protection Against War Gases 177
Advancement of Science in Soviet Russia 179
Public Relations for Chemical Industries 182
Thermodynamic Considerations in Corrosion of Metals 183
Allocation of Engineers According to Specializations 183

CHEMICAL ENGINEERING AND SOCIAL EDUCATION

WHAT INDUSTRY would like to have and must have are more chemical engineers who are resourceful, well trained in engineering fundamentals, and yet who recognize that fitness and the requirements for a job consist not only in the possession of technical knowledge but also the ability to work with other people of all classes and types. They must realize that most often things are simple until complicated by human behavior. Above all, they must have an overpowering desire to work hard mentally and physically. The odd part about this picture is the relatively small stress that detailed technical training is given.

To decide what will be needed after the war, we must first recognize the important factors that will probably control our economy. These can probably be divided into two classes: factors that follow natural laws and those which do not follow natural laws. These which do not follow the laws of nature are the complicated or social factors made by human behavior. During the last ten years these have been rapidly increasing, probably as a result of attempts to control the results of technical progress without equivalent advancements in the science of living.

Technological development is so tremendously accelerated during wars that it seems to take almost ages of peacetime work for humans to catch up socialogically. After this war our engineering educational system should develop desire in our young technical men to help solve the broad problems of how to gear technical problems to the broader field of economy and to the progress of civilization. A recognition on the part of each man that in addition to his technical work he has a very important job of understanding and participating in the problems of government and world relations may help prevent future wars. When the young engineer leaves school he must realize that he still must participate in an honest effort in government and should broaden his thinking as to humanity. Just as his chemical work resembles an equation where the result is a function of applied technical knowledge plus relationship with others, so the attainment of our present form of society is a function of our work plus our relations with the rest of the world. Science and technology are never static, therefore our laws, government, economy and other human relationships should not be static.

This war has caused education to stress the fundamentals and to give time only to those things that are most essential. This gives us an opportunity of modernizing our curricula and thinking in preparation for the post-war period. We should keep the fundamentals, but also attempt to develop the broad world thinking as to industry and living. The chemical engineer of the future will have more and more need for the study of other peoples, of languages, and certainly for economics.

Much of the college training in chemical engineering could well be interspersed with work in industries. This war is furnishing our colleges with a fine opportunity to develop a close relationship between themselves and industry. This mutual understanding will help us to progress and will keep technical education from becoming stagnant.

Paul D. V. Manning, director of research, International Minerals & Chemicals Corp., Chicago, Ill., before the national meeting of the Society for Promotion of Engineering Education, Chicago, Ill., June 18, 1943.

PRESSURE COOKED PLYWOOD

CURVED plywood has long been used for pianos, radio cabinets, doors, and other household items, but not until the development of molding complex curved forms with "flexible pressure" have plane fuselages, gliders and other vital plywood military parts become possible. The "flexible pressure" method has been recently pushed to commercial production, so that the relatively plentiful supply of plywood materials, equipment and manpower could be utilized.

The older method of gluing sheets of veneer into plywood has been to apply pressure in one direction only, distributing the pressure through rigid plates or blocks. This method is limited to forming curved pieces over a 90 deg. angle or sometimes over a 120 deg. angle. The "flexible pressure" method, on the other hand, can be used for curved pieces of irregular shape or for pieces requiring curves in more than one plane.

Fundamental principle of this method is using an inflated or deflated bag as

one of the halves of a pair of molding dies. In making a boat hull, for instance, layers of veneer are "wrapped on" a convex mold with heat-reactive resin between each layer. To mold the layers into a plywood shape, an inflated bag may exert pressure on one side, or the veneer-covered mold may be placed inside an open-mouthed bag, the bag deflated so that it adheres to the contours of the mold, and the whole inserted into an autoclave or "pressure cooker." A third method of applying the flexible bag is to lay the veneer strips on a concave thin metal mold supported by cross frames and drape a rubber bag in the mold. When inflated, the rubber tightly adheres to the mold. In the autoclave, this latter method applies heat to "cure" the adhesive more rapidly than the first two methods.

About 50 "cooks" are the normal expectancy of rubber bags, though some authorities claim to get 100. Studies are now being made on some type of paper or flexible plastic inexpensive enough to be used once and discarded after use. Developments in this direction give promise of a better flexible bag technique.

Thomas D. Perry, Resinous Products & Chemicals Corp., Philadelphia, Pa., before the spring meeting of the American Society of Mechanical Engineers, Davenport, Iowa. April 28. 1943.

COUNTERCURRENT ABSORPTION IN NON-AQUEOUS SYSTEMS

Absorption of the vapors of benzene, trichlorethylene, and chloroform by kerosene has been studied in a 1-ft. column packed with 1-in. clay Berl saddles.

According to the two-film theory of gas absorption developed by Whitman and others, the over-all absorption coefficient may be related to the gas rate by the empirical relation

$$K_g a = \gamma G^{\lambda}$$

for cases of absorption of a vapor very soluble in the extractor. $K_g a$ is the over-all coefficient, (lb. mols)/(hr.) (cu. ft.) (atm), and G is the gas rate, (lb.)/(hr.) (sq.ft.)

By studying the rate of absorption of the three vapors at gate rates up to 80 (lb.)/(hr.) (sq.ft.), and at liquid rates varying from 1,000 to 3,000 (lb.)/(hr.) (sq.ft.), it has been shown that the preceding empirical relation is valid, the liquid film resistance being negligible within the rate flow limits. Furthermore, the constants λ and γ in the equation have been determined for the three systems studied, and it has been found that the value of λ approaches unity.

W. F. Gross, Tretolite Co., St. Louis, Mo. and C. W. Simmons, Lehigh University, Bethlehem, Pa. before the American Institute of Chemical Engineers, New York, N. Y., May 10–11, 1943.

PRODUCTION OF WAXY CORN AND WAXY SORGHUM STARCHES

Prior to the war, waxy grains in the United States had been of interest chiefly to geneticists. When the Japanese occupation of Java virtually stopped importation of tapioca, industrial interest in waxy corn and waxy sorghum was

All the best features of "custom-built" heat exchangers in this standard design!

*Patent Appl. For

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The STANDARDIZED shell & finned tube HEAT EXCHANGER

Economical, multi-purpose SHELLFIN—highly efficient heater, cooler, condenser!

● With but slight variations in its basic design, SHELLFIN can be adapted to a wide variety of uses for heat exchangers. And, SHELLFIN's shell and finned tube construction and engineering features fully match the best among individually engineered units—in efficiency, but not in cost.

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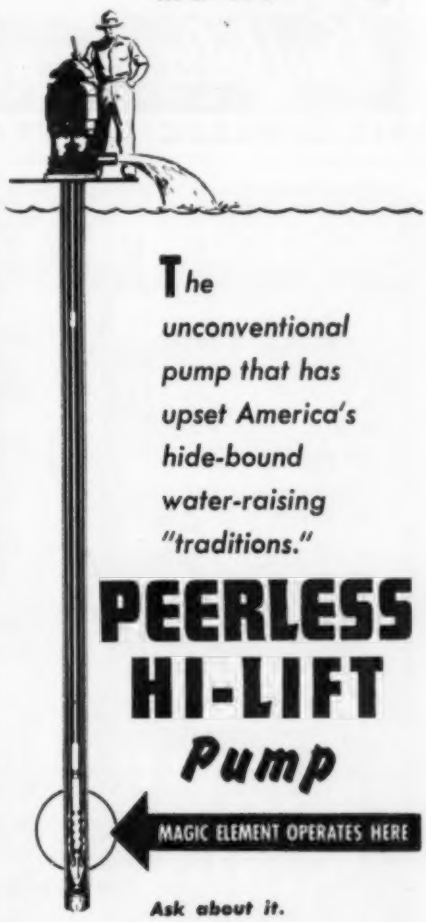

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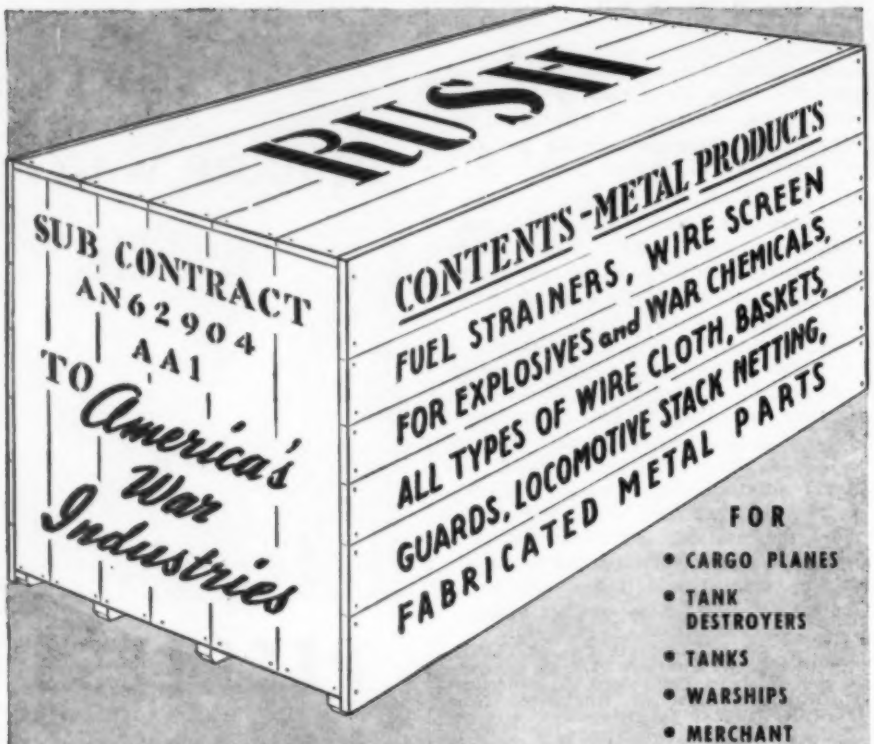

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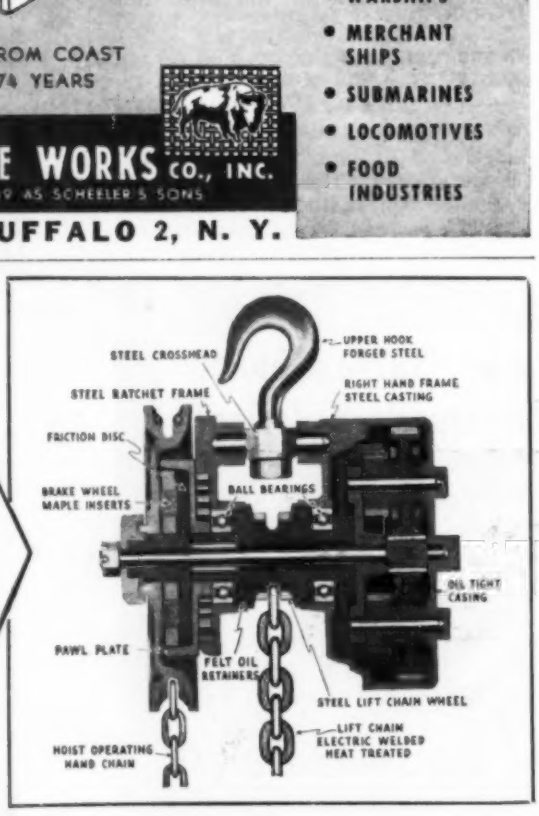

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greatly stimulated, since starches from these grains were most promising for tapioca replacement.

Waxy corn and sorghum usually contain about 5 percent less starch than the corresponding non-waxy grains. However, oil and protein, valuable byproducts in starch manufacture, occur in greater amounts in the waxy grains. Both waxy corn and waxy sorghum can be processed for starch by substantially the same method as that used for the commercial production of cornstarch. Sorghum varieties with colored seed coats present processing difficulties due to adsorption of pigment on the starch granules. White varieties have been developed, however, which obviate this problem.

Waxy cornstarch contains less nitrogen, phosphorus, and ash the lower the sulfur dioxide content of the steep used in processing; in the case of non-waxy cornstarch only nitrogen and phosphorus are similarly decreased. Waxy corn and waxy sorghum starches contain only about one-half as much phosphorus as non-waxy. In many cases, the waxy starches also contain less nitrogen.

Starches from waxy cereals give a characteristic red-brown coloration with iodine. The granules are readily injured by pressure, splitting into wedge-shaped fragments. In paste viscosity, translucency, low rate of retrogradation, and lack of flavor, waxy corn and waxy sorghum starches compare favorably with tapioca.

Available seed supplies of waxy corn and waxy sorghum are being increased rapidly. A small industrial crop is anticipated in 1943, and by 1944 all reasonable demands should be met.

M. M. McMasters and G. E. Hilbert, Starch and Dextrose Division, Northern Regional Research Laboratory, Peoria, Illinois before the American Association of Cereal Chemists, St. Louis, Mo., May 17–19, 1943.

LAWS GOVERNING GROWTH OF FILMS ON METALS

THREE laws have been established to express the thickness y of a film of oxide, sulphide or iodide formed on metal exposed to a non-metal for time, t:

$y = kt$ (Rectilinear equation)
$y = kt^2 + k_1$ (Parabolic equation)
$y = k_1 \log (kt + k_0)$ (Logarithmic equation)

where k_1, k_2, k_3, k_4, k_5 and k_6 are constant at any given temperature.

The linear law occurs with the porous film formed on light metals (for example, calcium) which allow inward leakage of oxygen or other non-metal. The parabolic law occurs with non-porous films possessing ionic and electronic conductivity (for example, those found on copper) and is governed by outward ionic migration under a potential gradient; it is usually associated with vacant sites in the cationic lattice.

The logarithmic law occurs when the conditions needed for parabolic thickening are absent (for example, on zinc) and is believed to be due to the outward passage of interstitial matter through flaw-paths or zones of loose structure in the outer part of the oxide film;

actual rate of passage along a given path is regulated by the rate of crossing a less pervious inner film of constant thickness and is independent of the thickness of outer film, provided that no obstruction occurs in the path through the outer film. If such an obstruction occurs, however, passage along the path in question becomes impossible, and clearly the chance of obstruction of a given path will increase with the film-thickness. It can be shown that the growth-rate will fall off with film-thickness in accordance with the logarithmic law.

Where a film, like that on aluminum, possesses a highly protective character (connected with its ideal composition and high electrical resistance) the formation of discrete cracks becomes an important factor in film-growth. Such cracking occurs in films on other metals.

U. R. Evans, Assistant Director of Metallurgical Research, Cambridge University, England, before the Electrochemical Society, Pittsburgh, Pa., April 8–10, 1943.

A NEW POTENT ORGANIC FUNGICIDE

THE COMPOUND 2, 3-dichloronaphthoquinone-1, 4 has been found to possess highly fungicidal properties in tests during the past three years. It is two to eight times as effective against certain fungi as several leading organic and inorganic fungicides in the phytopathological, textile, leather, and other fields. The fungicidal potency of 2,3-dichloronaphthoquinone-1,4 may be observed in slides which show control of *Pythium ultimum* on peas at dosages as low at $\frac{1}{32}$ percent by seed weight. Complete inhibition of spore germination occurred in slide tests with *Alternaria solani* at a dosage of one ounce per 100 gal. of water.

The fungicide shows promise against cotton anthracnose and Rhizoctonia damping-off at 0.75 oz. active material per bu. of seed. It also yielded good results on lima bean at 0.2 oz. and on corn at 0.25 oz. per bu. of seed. The chemical appears to have value in the control of certain diseases of wheat and other cereals. 2, 3-dichloronaphthoquinone-1,4 has been found to be an excellent mildew-proofing agent against Chaetomium and Metarrhizium spp. for the protection of leather and cotton fabrics. Application may be made in the form of a paste, solution, suspension, or vapor. 2,3-dichloronaphthoquinone-1,4 should prove an especially safe and potent fungicide for many purposes.

W. P. terHorst and E. L. Felix, General Laboratories, United States Rubber Co., Passaic, N. J. before the American Chemical Society, Detroit, Mich., April 12–16, 1943.

PROTECTION AGAINST WAR GAS INJURIES TO CITIZENS

THE THREAT of using war gases against civilian populations is a powerful psychological weapon. Since most people know nothing about war gases, they are afraid of them. This fear maintains a high panic potential which is what the enemy wants. The obvious way to reduce the possibility of panic among civilians if war gas is used against

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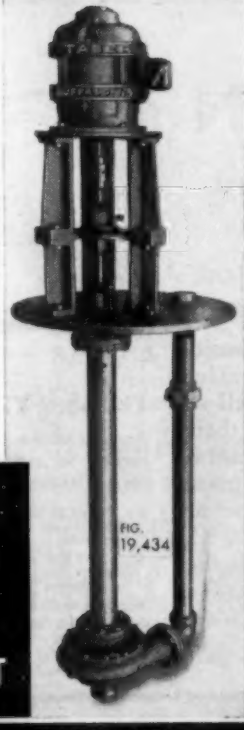

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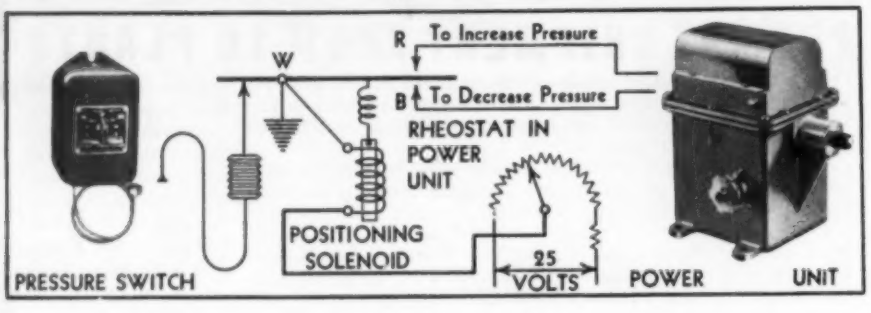

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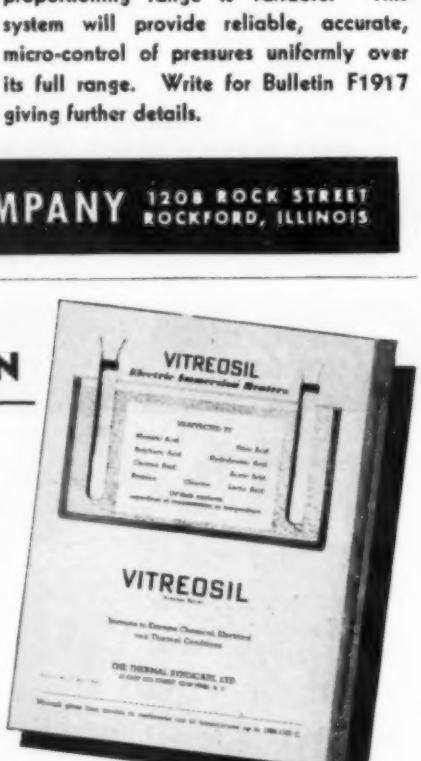

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them, is to give civilians all the knowledge possible.

There are many common mistaken ideas about war gases. War gases are usually thought of as horrible weapons which may cause a terrifying death, or severe or permanent injury. Experience does not justify these beliefs. These false notions probably developed from the customary fear of the unknown.

In World War I, 2 percent of all men injured sufficiently by war gases to be recorded as casualties died from exposure to these chemicals. On the other hand, 24 percent died of all who were wounded by shell or bayonet. On the basis of World War I experience, it is twelve times more dangerous to be injured by shot or bayonet than by war gas.

Nor were residual effects from exposure to war gases as severe as ordinarily believed. A careful survey by the U. S. Public Health Service during the early thirties showed that the incidence of lung disease and various other disorders which might feasibly be related to war gas injury, were just the same among men who had a record of exposure to gas as among the general population of the same age group.

Civilians may protect themselves most effectively against either bombardment or airplane showering with gases by obeying air raid rules. The vapors from war gases are fairly rapidly dissipated by wind, so that if civilians take shelter in air raid shelters, with doors and windows shut, they are not likely to be exposed to irritating vapors from war gases unless doors and windows are broken open by bombing.

If doors and windows are broken, and if it is suspected that any sort of irritating vapor is in the air, civilians should be prepared at once to tie a wet cloth or handkerchief over the nose and mouth.

Best protection is ordinary kitchen bleach solution, such as Clorox. This will destroy most war gases. In general, war gases are poorly soluble in water, so that the water screen across the nose and mouth will protect the delicate membranes of the lungs. If the eyes, nose, or throat are irritated, they should be washed with a solution of a teaspoonful of baking powder in a glass of water. This is roughly equivalent to a 2 percent solution of sodium bicarbonate.

If liquid war gas is spattered upon, or is dropped upon clothing, the clothing should be promptly removed and thrown out the window. It can later be cleaned by a decontamination squad.

If liquid gas spatters on the skin, it should at once be daubed, and not rubbed, with a cloth wet with kitchen bleach solution or with soap and water. Care must be taken not to spread the material. Solvents such as kerosene are apt to be dangerous since they may spread the liquid over the skin. The effects of nitrous fumes from high explosive shells may be as serious on the eyes and lungs as a real war gas.

It is apparent from these relatively simple rules that civilians may take care of themselves in the event of war

gas attacks with equipment readily available in every household. There is no reason for ordinary civilians to be supplied by gas masks. It would be better to use the rubber and steel to make offensive weapons with which to beat the enemy in his own backyard. Of course, air raid wardens, firemen and police, as well as decontamination squads must be provided with special protection, but the ordinary civilian may easily take care of himself.

C. D. Leake, University of Texas School of Medicine, before the 105th meeting of the American Chemical Society, Detroit, Mich., April 13, 1943.

SCIENCE IN SOVIET RUSSIA

SOVIET planners were quick to realize that if the country were to be electrified, an immense electrical industry must be created, and with it an expansion of the study of physics. Plans for creating a new generation of physicists were accordingly begun, under the direction of A. F. Joffe. As early as 1918, he started the Physico-Technical Institute at Leningrad, with an original staff of eight.

By 1929 the Institute had grown to about 700 students in various laboratories, and about 1,300 assistants and workmen. It was able to provide large numbers of physicists for the First Five Years' Plan. This involved construction of new industrial regions and numerous new technical plants throughout the country. In each region appropriate new scientific institutes had to be created. Thus a series of new physical research institutes came into existence at scientifically strategic centers. The first to be built was at Kharkov, to serve the new physical needs of the Ukraine. Other institutes were founded at Dniepropetrovsk, Sverdlovsk, Tiflis and other centers.

The new institutes have special lines of research appropriate to the needs of the locality. At Kharkov, the Physico-Technical Institute had large departments of research in high-tension physics and in low-temperature physics. At Dniepropetrovsk, special attention was given to metallurgy, which served the needs of the big steel and aluminum works in the neighborhood. The Physico-Technical Institute at Sverdlovsk, which specializes in metallurgy, has departments for study of alloys, electrical and magnetic properties of metals, mechanical properties, such as cohesion and plastic deformation, and the theory of metallic properties.

Soviet planners attach as much importance to human as to natural resources. This is the reason why the founding of special institutes for men of outstanding ability has been a feature of the scientific development. For instance, an institute for the study of experimental genetics was built near Leningrad for the famous physiologist, I. P. Pavlov. A fine Institute for the Study of Physical Problems has been built in Moscow for P. Kapitza, and an Institute of Chemical Physics at Leningrad for N. N. Semenov.

Importance of the Academy of Sciences in planning of scientific devel-

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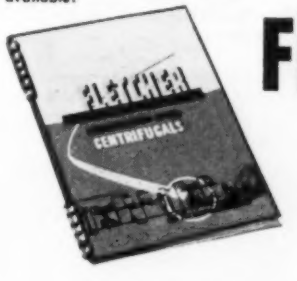

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opment and research has steadily increased, and now it is directly responsible for this work to the Supreme Soviet. The Academy determines the general lines of scientific work, in accordance with the needs of the state, and possibilities in subjects and personalities. It sees that balanced attention is given to all sides of science.

Actual planning of research programs proceeds simultaneously from the top and the bottom. In every institute the research staff prepares a program for each year's work. The heads of departments reduce these proposals to plans for their departments, and the director incorporates the departmental plans into one for the institute. The Academy then calls a meeting in Moscow of the directors of institutes working on the same line. Their various plans are compared and coordinated, and adjusted to meet the Academy's general directives. More than this, science is directly represented in the Supreme Soviet by a leading scientist.

The Academy's plan of research for 1943 is mainly directed to the improvement of war industries and armaments. Geologists are engaged on the exploration and study of new sources of oil, ores and minerals, especially in the Urals, West Siberia, Kazakhstan and the Middle Volga regions. Agricultural scientists will devote special efforts to increase the yield of cereal and industrial crops such as rubber-bearing plants, potatoes and beets.

Joffe describes how a small group of his colleagues at the Physico-Technical Institute at Leningrad remained in the city during the siege. In spite of the terrible conditions they continued research which gave considerable results. He saw one group of physicists that did not leave their laboratory for three weeks, snatching intervals of sleep on their benches. But at the end of the three weeks they were able to send a large apparatus away for testing.

At Kazan, physicists worked in the open air with bare hands at temperatures of —45 deg. C. The metal of the instruments froze to their skin and tore it off. But not one of them stopped until the work was done.

Hundreds of research institutes costing half a million dollars or more have been built. Research scientists have been trained in thousands, and applied scientists and engineers in hundreds of thousands. These have been reared on a basis of elementary scientific education given to millions.

What scientific results have been obtained? In geology, there has been the discovery of stupendous new mineral deposits. Before 1917 less than 10 percent of Russia had been surveyed. Now 50 percent has been surveyed, and it has been found that the Soviet Union has larger resources than any other country in iron, manganese, apatite and potash; and the second largest in coal, zinc, lead and nickel. With the exception of tin and tungsten, the country is virtually self-supporting in minerals. During the last 15 years these have been developed at a remarkable speed.

Improvement of agriculture by the application of science has led to important results. Lysenko has developed the technique of vernalization for wheat whereby the seed of winter wheat is treated with heat and moisture, which brings it to the stage it would have reached if it had lain in the ground through the winter. This enables some of the most productive kinds of wheat to be grown in districts where they were not formerly cultivatable, leading to big increases in production. Lysenko has also developed the use of potato tops in place of seed potatoes. In 1942 average crops of potatoes were secured from 75,000 acres of land planted with potato tops instead of seed potatoes.

Some of the most striking research has been done by Semenov in chemical physics. His studies of the breakdown of insulation under high-voltage current directed his attention to the branched tracks through the insulation, and how these might have been formed by the passage of electricity from atom to atom. He began to apply this notion of chains of reactions between particles to chemical phenomena and succeeded in explaining why under certain conditions phosphorus does not always combine with oxygen. Semenov and his school have given a mathematical theory of many features of chain reactions. Through their work, Soviet military scientists have advanced knowledge of subjects of such importance today as detonation in aircraft engines and explosives.

Kapitza, well known in England, has recently invented a new method of liquefying gases by making them do work in a small turbine. This removes the energy at an enormously greater rate than by the Joule-Thomson effect, used in the ordinary liquefying apparatus. For instance, instead of compressing air to 200 atmospheres, Kapitza starts with air at only 5 atmospheres. The apparatus is compact, efficient, and delivers liquid air within a few minutes.

Although the number and equipment of Soviet scientific institutions is impressive, the chief quality of Soviet science is in the spirit of the scientists. One frequently finds large research laboratories, which may have cost a million dollars, almost entirely staffed by men and women under the age of thirty. The heads of research departments are usually in the thirties, and the majority of the research workers are in the twenties. This atmosphere of youth is very striking, and is accompanied by great enthusiasm and energy.

Social life in Soviet institutes is highly developed and integrated. Planning of the research and relation of the institutes' work to industrial and political affairs are the subject of continuous organized discussion. In this the Communist Party takes the lead. As a rule, not more than 10 or 20 percent of the staff are members of the party or candidates for membership. The percentage among research workers is lower.

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If he makes important discoveries or inventions he may receive monetary awards. Stalin prizes are now given for the best cultural work. These consist of first prizes of about $40,000 and second prizes of $20,000, and about one hundred prizes awarded annually for science and invention.

Stalin awards for 1942 announced on March 23, 1943, include prizes of $40,000 to P. Alexandrov for topology, to P. Kapitza for research on the superfluidity of helium II, to S. V. Orlov for research on comets. Lysenko and his colleagues received a first prize for their work on potato tops as substitutes for seed potatoes.

A sum of about $360,000 has been distributed among aviation scientists alone, and a total sum of some $2,000,000 to scientists in general. This is a new phenomenon in history. Never before have scientists had such prospects.

J. G. Crowther, Secretary of the Science Committee of the British Council, in his Trueman Wood lecture to the Royal Society of Arts, London, England, April 14, 1943.

PUBLIC RELATIONS FOR CHEMICAL INDUSTRIES

A LABOR leader is not held to accurate statements as is a corporation executive, but there is no denying that the labor leader has out-maneuvered, out-talked and out-influenced the American industrial executive by getting his story to the public first, more dramatically, and apparently with a tone of greater sincerity.

One reason for this better public relations record on the part of labor is that such functions in the more aggressive, more successful labor organizations are not delegated to clerks.

It is the serious responsibility of industry to make sure that the facts of every debatable situation are made available so that a free press can present a fully-rounded picture and maintain its standards as the American safeguard against bureaucrats. There are six rules for corporation heads to follow that will be helpful in presenting the chemical industry's story to the public. They are:

1. Put qualified executives in labor relations and public relations posts and give them the utmost confidence.

2. Give these men the authority to establish policies that will put industry on the morally right side of any argument instead of being merely on the side of legal right.

3. Make sure that executives in charge of labor relations and public relations interchange ideas and viewpoints constantly.

4. Place plant publications in the hands of a trained newspaper man grounded in the fundamentals of labor relations.

5. Think fast and act first in telling the company's side of a labor dispute to the public through the press and radio,

even to the extent of announcing a strike and scooping an international labor representative.

6. As heads of industry, make yourselves available for questions and all-cards-on-the-table interviews with the press whenever occasion warrants.

Let industrial executives adopt some of the tactics that have been used by the bureaucrats and by labor agitators. Let them be outspoken. Let them fight, when there is reason to fight, and for a change let them get in some of the first blows. So long as there is a free press, the way is wide open for industry to compete successfully with labor in the matter of public relations.

James W. Irwin, assistant to the president, Monsanto Chemical Co., St. Louis, Mo., before the Industrial Relations Institute, Edgewater Park, Miss., March 12, 1943.

THERMODYNAMIC CONSIDERATIONS IN CORROSION OF METALS

THE CONTRIBUTIONS which the science of thermodynamics can make to the study and elucidation of corrosion reactions can be discussed under two headings. The first is the use of the principles of thermodynamics and thermodynamic data to calculate the spontaneity or non-spontaneity (free energy change) of corrosion reactions when specified metals are placed in specified environments. If the corrosion process occurs by an electrochemical mechanism, the maximum (reversible) potential of the corrosion couple may be calculated and this potential may be considered the driving force of the corrosion process.

Secondly, if the proposed or actual corrosion process is spontaneous, one may state the conditions for the steady state limiting corrosion rate by setting the free energy decrease in the process equal to the sum of the energies dissipated in the various parts of the electrochemical system. For convenience in discussing the conditions for the steady state, the energy liberated and the various energies dissipated in the process are converted into potentials. This leads to the steady state condition that $E\ (reversible) = \Sigma_i\ E'_i$ (irreversible, back, or dissipative e.m.f.'s).

J. C. Warner, Carnegie Institute of Technology, Pittsburgh, Pa. before the Electrochemical Society, Pittsburgh, Pa., April 8–10, 1943.

• • •

Approximate Allocation of Engineers According to Fields of Specialization[1]

	Number Active December 1942
Mechanical[2]	94,000
Civil[3]	87,600
Electrical[4]	59,400
Chemical	16,700
Mining and Metallurgical[5]	11,700
Industrial	10,600
Total	280,000

[1] National Roster of Scientific and Specialized Personnel of the War Manpower Commission, April 21, 1943.
[2] Includes aeronautical, automotive, heating and ventilating, air conditioning, marine and agricultural.
[3] Includes architectural and sanitary.
[4] Includes radio and communication.
[5] Includes petroleum and ceramics.

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Bemis WATERPROOF Bags
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They're loading freight cars and trucks to capacity these days. And that puts *extra* strain on the lower layers of bags. Tough, strong Bemis Waterproof Bags have the strength to stand up under today's shipping conditions, yet they are extremely low in tare weight.

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Chemicals, high-octane gasoline, synthetic rubber, and many other products necessary for the successful conduct of the war, have placed a tremendous burden on the manufacturers of processing equipment. The number of Government-sponsored plants built at strategic locations all over the country have called for equipment—and more equipment—much of it of new and complicated design.

Babcock & Wilcox, with its many years' experience in designing and manufacturing process equipment, has taken a leading part in supplying much of it. The B&W facilities for manufacturing high-pressure vessels, drums, towers, tanks, and steel tubing are unsurpassed. The B&W welding technique, augmented by heat-treatment and X-Ray, are guarantees of safe, efficient, and economical products.

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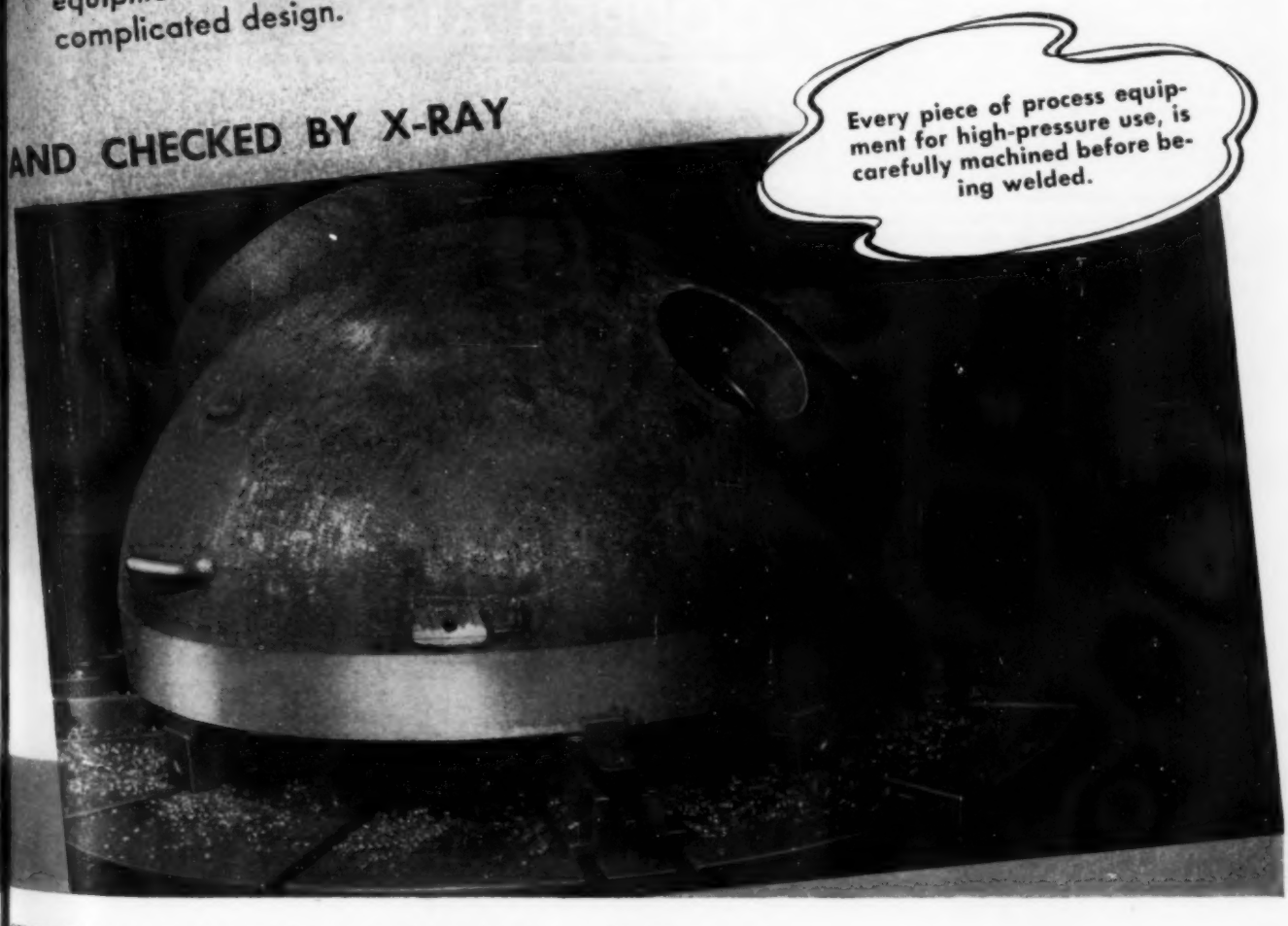

Every piece of process equipment for high-pressure use, is carefully machined before being welded.

TIME IS EVER FLOWING FASTER

"The duration"—which not so long ago seemed to be unpredictable, is now visualized over not so many tomorrows. Close upon the heels of Peace will come urgent new calls for greater industrial activity. The fields of expanding commerce will extend far beyond the Continental United States. American business men will send their wares to, and establish their plants in many foreign lands.

It will be an age of quality, efficiency and speed! It will be an age in which Layne, with more than sixty years of outstanding success will enjoy even greater achievements. Innovations, discoveries and improvements made by Layne for Military and Naval use will speed the installation of wells. Pumps of greater capacity and higher efficiency will be in production. New hydrological engineering developments will be made available for all manner of industrial, commercial and agricultural use. Layne will brilliantly maintain the position of world leadership in the well water development field.

Layne Pumps and Well Water Systems have long been miles ahead of competition. They are basically sound and proven in quality. They embody the most advanced engineering features. They are sturdy in construction, unequaled in efficiency and outstanding in reliability.

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NEWS FROM ABROAD

DOMESTIC DISTRIBUTION AND EXPORT METHODS CHANGED UNDER BRITISH CONTROL SYSTEM

Special Correspondence

PREWAR methods of distribution have no place in Britain's economic war organization and are indeed now often deprecated as costly or even harmful. There is no need for high-pressure salesmanship in present supply condition, but the Ministry of Supply has followed the policy of utilizing the experience of existing traders while eliminating wasteful competition by formation of joint distribution agencies in the somewhat unusual legal form of a "company limited by guarantee." Traders in a commodity who qualify by reason of standing and turnover are organized in these no-capital companies under the control of the authorities to distribute to their customers materials imported under the auspices of the Government. In the chemical trades this system has been working well, according to the report of the British Chemical and Dyestuffs Traders' Association, and it has been extended in a direction of special interest to importers in the United States. At the request of the Coal-Tar Controller joint consultations were held between the coal-tar products group of the Association and the tar-acid producers with the object of setting up an organization to facilitate exports of cresylic acid to the United States.

These discussions open the prospect of an export system for the future which would certainly be far remote from the rugged individualism of prewar days. The Association reports that during 1942 export trade, though much curtailed by war conditions, was comparatively satisfactory, and a fair volume of business in essential materials for approved destinations was handled by the merchant exporters. Yet "the present tendency to centralize exports to the Colonies and Dominions through one buying agent is causing not a little anxiety" to established exporters who argue that "a revolutionary policy is bound to have a retarding effect on the development of postwar export trade, inasmuch as the merchants will be powerless to compete with other exporting countries

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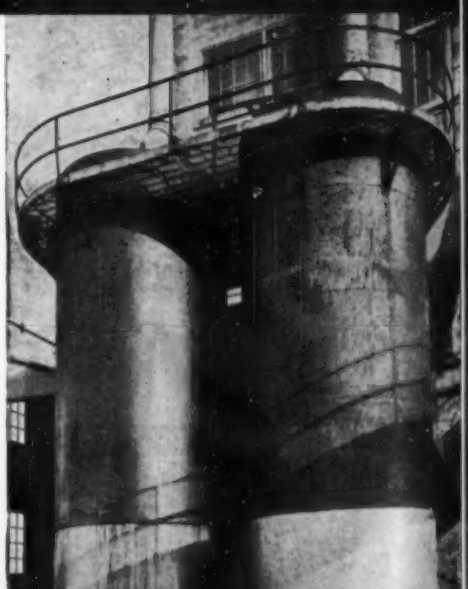

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of established connections are to be severed by official action."

The problem of exports also features prominently in the annual report of Imperial Chemical Industries, the British chemical and dyestuffs trust. It stated that considerable quantities of exports have been safely carried through all perils to their destinations. In maintaining supplies for our export markets we have once more benefited by the willing assistance afforded us by our subsidiary and associated companies in the British Empire as well as by the same efficient help from our American friends. Our business with Far Eastern markets remains practically at a standstill, but we are giving much study to the problems which will arise after the war, both there and in other overseas territories.

The company's report which owing to I.C.I.'s far-reaching interests in all sectors of the chemical industry normally provides a review of the whole of Britain's chemical trades is necessarily limited in scope on account of the war. It is stated, however, that the entry into the manufacture of pharmaceuticals has been accelerated because many important drugs had formerly been available solely from Germany, until recently all I.C.I. activities in this field were co-ordinated by the formation of Imperial Chemical (Pharmaceuticals) Ltd. During the years immediately before the war the company had pursued the objective of discovering new pharmaceutical substances, a policy which proved certainly very advantageous when a fresh situation arose with the outbreak of war.

New Bonding Process

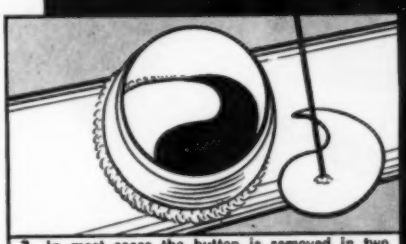
Two new developments in the combination of plastics and metals for constructional and mechanical purposes draw attention to a border region of both these industrial materials which promises to grow in importance in the future. One English firm has developed a process which provides, through the use of synthetic resin adhesives, a method of bonding light alloys and steel with a strength exceeding that of riveting. Strong joints can also be obtained in this way between metal and wood, and the process is likened in its importance to the introduction of synthetic resin adhesives in plywood manufacture. The other new process has the purpose of reducing the porosity of metal castings by treatment under moderate pressure with a special sealing solution, followed by controlled heat treatment in a suitable oven. Equally satisfactory results are claimed for ferrous and non-ferrous metals and light alloys. In general terms, the process consists in impregnation of the castings with the resin solution and conversion of the resin into the non-fusible state.

The "battle for food" has been fought with increasing vigor by British agriculture, and as more acres have been brought under the plough and extensive grassland farming gives way to intensive cultivation, the demand for chemical fertilizers has risen steadily and overtaken the potential supply. Yet there is one fertilizer material which is

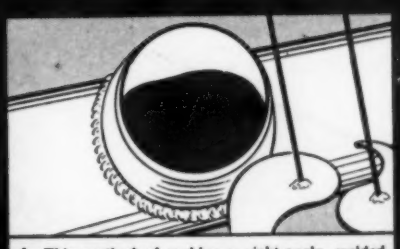
These 6 Steps Save Vital Man-Hours in Piping Installations

1—Install W-T's* anywhere on the main pipe without cutting, forming or fitting of the pipe. Simply select position of right-angle branch outlet and tack the fitting into place.

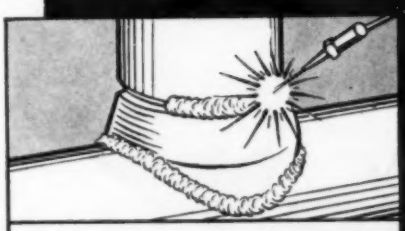
2—After tacking to insure the exact location of the W-T*, complete its installation by electric-arc or oxy-acetylene welding—following and filling the bevel at the base of the fitting.



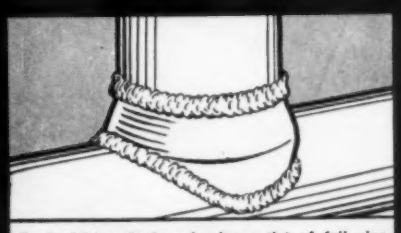
3—In most cases the button is removed in two sections with a torch after the WeldOlet or ThredOlet is installed—but where the outlet is smaller than 2", the hole should be cut in the main pipe first, using a drilling or hole saw.



4—This method of making a right-angle, welded branch pipe outlet insures a junction of full pipe strength—permits inspection of inside of junction—allows removal of slag and excess weld metal.



5—Branch pipe is attached by welding to outlet of fitting if WeldOlets or Socket-End WeldOlet has been used—or screwing into threaded outlet of fitting if a ThredOlet has been used.



6—A right-angle branch pipe outlet of full pipe strength has been made without the use of templets, without threading or fitting the main pipe and because of the patented design of the fittings—flow conditions have been improved.

3 Types Meet Every Need

Made of drop forged steel — to provide maximum strength. Available for all standard pipe sizes up to 24".

Branch pipe is attached to outlet of WeldOlet with plain, butt weld—to ThredOlet by screwing into threaded outlet of fitting—to Socket-End WeldOlet by weld around top of fitting after slipping branch pipe into outlet.

*WeldOlets-ThredOlets

Other Advantages

Lightweight compared to screwed or welding tees—saves metal—eliminates need for extra hangers and braces.

Elimination of exterior obstructions makes neater, more workmanlike installation, permits easier covering with insulation.

Adaptable to any and all types of piping systems—pre-fabricated or "on-the-job" assemblies—new construction or maintenance.

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still needed in larger quantities and it can be produced in the British Isles. Occupiers of agricultural land receive a subsidy for lime bought during summer, and this has now been raised from 50 to 60 percent. The results of government encouragement to agricultural lime consumption have been startling. Before the war only 400,000 tons of lime were used every year. During the current year the amount of lime needed was estimated officially at 4,000,000 tons, including 1,000,000 tons of burnt lime and 1,000,000 tons of waste lime. Many producers make lime solely for agricultural purposes, but this seems to lead inevitably to high prices for agricultural lime in some regions, and it is pleaded that the lime industry would fare better, to the advantage of the farmers, if a standard price were charged for agricultural lime throughout the country, thus removing the handicap under which British farmers in remote districts are laboring now, and if more attention would be paid to lime as a chemical raw material since chemical manufacturers would be able to pay higher prices and thus to subsidize indirectly the agricultural lime consumer, while at the same time removing some of the disadvantages resulting from the strictly seasonal character of agricultural demand.

The future of lime as a chemical raw material for British industry depends, however, to a large extent on the provision of cheap power for electrochemical industries. It is interesting to note that in at least two formerly depressed areas these questions have been studied most attentatively. In South Wales electrochemical industries including the manufacture of calcium carbide, acetylene and derivatives on a greatly increased scale are considered desirable also because valuable coal byproducts would be obtained. In Scotland development of a large electrochemical industry would make it possible to supply agricultural lime at lower cost and to make better use of the hydroelectric resources. While private enterprise might find the investment of the necessarily large funds in big electrochemical plants an undue risk, there can be little doubt from the national economic point of view that such investments would in the long run prove very valuable.

Plant Pest Control

Plant pest control which has also received increased attention lately is likely to profit from a scheme for the official approval of proprietary products for the control of plant pests and diseases which has the backing of the Ministry of Agriculture and the Association of British Insecticide Manufacturers. Lead arsenate powders, lead arsenate pastes, lime-sulphur, miscible tar-oil winter washes, stock emulsion tar-oil winter washes, and organo-mercury dry seed dressings will be first considered. In the meantime promising experiments have been made with clinker dust against grain weevils. The experiments have not been conclusive, but suggest that wet ground clinker dust of suitable particle size is effective.

In view of the large quantities of material required, road building has become a difficult task in all the belligerent countries in Europe, and in Germany it has even been necessary to omit repairs to the net of "Autostrassen" which dissect the country and were to play a prominent part in war transport. In Great Britain repair work has also been reduced and indigenous materials are used wherever possible. It is the government policy to secure the fullest possible use of coal-tar products in place of bitumen for manufacturing processes and for roads and runways. The quantity of bitumen used for road construction is relatively small now as compared with fluxed pitch, and the latter product receives preference where it can be used with satisfactory results.

PARAGUAY REGULATES OUTPUT OF QUEBRACHO EXTRACT

Quebracho production in Paraguay during 1942 is recorded at 49,079 metric tons, compared with 46,232 tons in 1941. Although actual output increased, the industry as a whole had to face many difficulties. Changing market conditions resulting from the war cut off most of the important European consumers, the United Kingdom being practically the only remaining buyer.

Since the potential productive capacity of Paraguay's quebracho industry has for some time greatly exceeded the demand for extract, efforts have been made to confine production to demand, allowances being made for adequate reserves. At present, efforts to plan production are governed principally by the availability of shipping space and the essentiality of quebracho extract to the war effort. Despite these drawbacks, Paraguay's exports of quebracho extract during 1942 increased by more than 10 percent over the preceding year.

PHOSPHATE ROCK PROSPECTS IN NEW ZEALAND

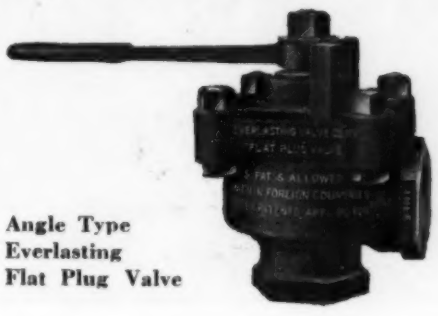
The British Phosphates Committee will make available in New Zealand 160,000 tons of phosphate rock for the current season, according to an announcement by the Assistant Director of Agriculture.

A contract also has been made for 20,000 tons of low-grade Clarendon rock containing from 10 to 12 percent phosphate. Low-grade superphosphate has been produced from this rock, and experiments in making a high-grade material are said to have been satisfactory.

ALCOHOL PLANTS IN EIRE WILL NOT OPERATE

Since Eire has no potato surplus, it is not expected that the industrial alcohol plants in Labbadish and Carndonagh will open this season. The Cooley plant, which was the only one of the five industrial-alcohol factories in operation this year, has been able to obtain small supplies of potatoes. Formalin is also produced at this factory.

Why the EVERLASTING FLATPLUG Valve



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Remains dependably tight through long years of service and frequent operation.

2. TIME-SAVING

Provides quick opening and quick closing with a quarter turn of the handle.

3. WITHSTANDS ABUSE

The faces cannot be jammed by the operator; cannot be shut too tight.

4. ADAPTABILITY

Suitable for use with air, gasoline, oils, syrups, steam, water, and other fluids.

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Valve seat lifted out with the fingers; renewal of all working parts can be made in 5 minutes.

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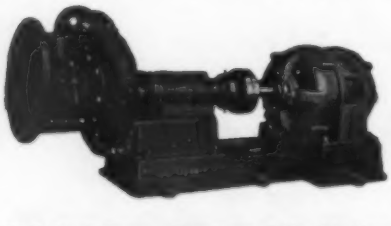

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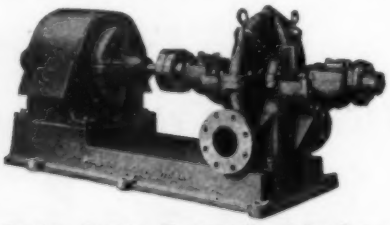

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CENTRIFUGAL PUMPS

INDIA STUDIES METHODS FOR PRODUCTION OF PLASTICS

Particular attention has been given in India to the development of methods of producing plastics.

Although synthetic resins are not available, natural resins and materials such as shellac, casein, oilseed cakes, and cellulose wastes are plentiful. Plastics have been produced from coffee beans, oilseed cakes, bagasse, jute waste, and horn waste. Several types of resins have been evolved, starting with vegetable oils.

Investigations were made to develop a process for producing formaldehyde, needed in the manufacture of synthetic resins, by the oxidation of methanol, which is available in India. Successful tests have been carried out on a pilot plant. It has been established that furfurol, also important in the plastics industry, could be manufactured economically on a large scale.

NEW USES FOR SHELLAC FOUND IN INDIA

Experimental work by the Indian Lac Research Institute in developing new uses for shellac has made substantial progress, and special attention has been given to practical application of the results, says the British press.

The production of shellac molding powders is considered particularly important, as their use in the manufacture of electrical goods and household articles opens up a new field. Additional research has been undertaken and processes worked out for the production of plastic molded articles, automobile finishes, and stoving enamels from shellac. Emphasis has been placed on the use of domestic materials in processing shellac for these new industrial purposes.

MAGNESIUM COMPOUNDS NOW MADE IN AUSTRALIA

Many magnesium compounds are now being manufactured by an Adelaide, Australia, firm, the British press reports.

Products include both light and heavy carbonate of magnesia, needed in the rubber, paint, leather, scientific glassware, firebrick, and other essential industries.

Magnesium sulphate has been produced by the company for many years from deposits of magnesite in South Australia.

BRITISH EAST AFRICA HAS NEW CHEMICAL PROJECTS

A number of projects initiated by the East African Development Board for the manufacture of chemicals are now under way, the British press reports.

A caustic soda factory has been completed, and plants are being established for the production of sodium silicate, copper sulphate, sodium sulphide, sodium arsenite, pyrethrum extract, and other chemicals from domestic raw materials.

ABSTRACTS FROM FOREIGN LITERATURE

DIESEL FUEL FROM VEGETABLE OILS

CONSIDERABLE interest has been aroused recently in the use of vegetable oils as fuels for Diesel engines. It has been shown by extensive and practical experiments in French Africa, chiefly in Senegal, that such motors run very well on vegetable oils such as cottonseed, kapok, peanut and coconut.

Since there is great need for motor fuel for agricultural tractors and similar engines in Brazil, certain authorities considered it worth while to make a serious study of this source. Experiments were conducted on the pyrodistillation of oil-containing seeds, the preliminary work being done with sunflower seeds which are readily available. The material was pyrodistilled in the presence of 5 percent pure lime at a maximum temperature of 600 deg. C. and the distillation product then condensed. Seeds with an average oil content of 20 percent gave the following results:

Distilled oil	29.7 percent
Acid liquors	17.4
Carbon residue	30.7
Gases	22.2

The oil was washed with a solution of sodium carbonate and fractionated, resulting in a product distilling between 70 and 300 deg. C., and a dark-colored, dense residue. The total oil separated out was 80 percent.

Experiments conducted with castor oil beans resulted in similar products. The residual carbon, in briquette form, was suitable for use in charcoal-burning motors and the gas could be used as a fuel or for chemical synthesis. The method offers sufficient advantages to merit further investigation.

Digest from "Pyrodistillation of Vegetable Oils" by Antonio Furia, *Revista Brasileira de Quimica* **XIV**, No. 83, 328, 1942. (Published in Brazil.)

AGING OF OIL

APPARATUS used up to this time for the study of the complex aging process of oils has a number of disadvantages. The work is ordinarily carried out under room conditions so that the samples are exposed to changes in the humidity, temperature, light, etc., and the test requires from 1 to 2 months. On the basis of a study on these and other influencing factors, the authors of this report developed a new type of apparatus for studying the aging of oils.

The new apparatus consists of a steel container with a chrome plated or enamelled interior surface. It can be hermetically sealed and the cover is provided with two connection pipes for the admission and outlet of the gas and a third for attaching the manometer with a safety valve. A tube for the introduction of oxygen is attached to one connection from the inside of the cover. Both connection pipes are provided with well

Spraco Flat Spray Nozzle

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For industrial processes involving washing, cooling, spraying, scrubbing, and quenching, Spraco Nozzles are available in a complete range of types, sizes, and capacities. Standard materials are cast iron, brass, and bronze, but nozzles for use with corrosive liquids and gases can be supplied from any machinable alloy (with suitable priorities).

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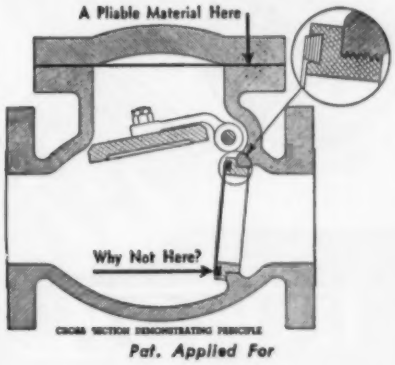

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ground cocks. The temperature in the apparatus is regulated by a thermoregulator and controlled with a thermometer placed in a pocket. The center of the cover is provided with an aperture through which are inserted the wires leading to a lamp. To make the container air-tight, the inner part of the aperture is filled with bakelite mixed with asbestos.

Inside the apparatus is an ordinary 100-watt, 23-v. projection lamp. The paints and films subjected to experiment are placed on a screen of stainless steel. A layer of silica gel is put under the screen to absorb the oxidation products from the decomposition. A lead lining is used to make the apparatus tight between the cover and the body.

On the outside the apparatus is covered with a heat insulation material. The lamp inside the apparatus is the source of heat. The temperature is regulated either by a change in the voltage supplied the lamp or by connecting a maximum relay into the circuit. The temperature did not fluctuate more than ±1-2 deg. in the experiments. Oxygen pressure in the apparatus is provided from a cylinder equipped with a reduction valve. On testing films containing resinous ester compositions, it is necessary to have moisture present. In this case the silica gel is not used, and a certain amount of water is introduced before the experiment to create a definite humidity under the given conditions.

Digest from "Investigations on the Polymerization and Drying of Oils and Esters of Fatty Acids. IV Heat of Aging of Films of Linseed Oil and Method of Rapid Aging" by A. J. Drinkberg and K. V. Ryashentsev. *Zhurnal Prikladnoi Khimii* **XV**, No. 5, 346–353 1942. (Published in Russia.)

FLUORIDE FOR ALUMINUM DETERMINATION

Sodium fluoride has been found to be the only reagent which precipitates aluminum in the presence of the other elements in an alloy without simultaneously precipitating the other chemically similar elements. The use of this reagent thus makes it possible to make a direct determination of aluminum in the presence of such elements as cobalt, nickel, zinc, chromium, manganese, iron, titanium and silicon.

In determining aluminum in the presence of cobalt, nickel, zinc and chromium, the alloy is first dissolved, treated with an excess of sodium fluoride and centrifuged to separate out the precipitate which is difficult to filter. The clear liquor is siphoned off and the residue treated with an 0.5 percent solution of sodium fluoride. The precipitate is then stirred and centrifuged again. This treatment is repeated two to three times and then the precipitate is washed in similar fashion with a water-alcohol mixture, dried at 130 deg. C. and weighed.

Certain variations are introduced into this method when aluminum is determined in the presence of any of the remaining four elements. Iron, for example, is trapped by the cryolite precipitate which must be reprecipitated before it can be weighed. Titanium also contaminates the cryolite precipitate,

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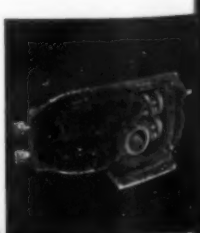

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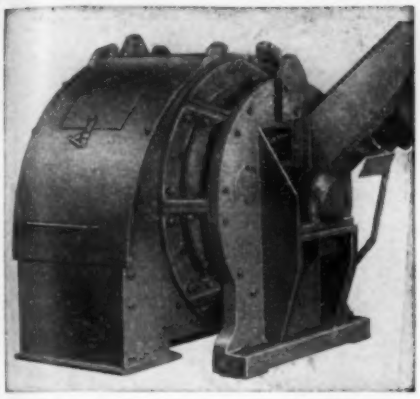

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and in the presence of that element, aluminum must be precipitated with the addition of ammonium oxalate. This serves to combine with the titanium to form complex ions.

Digest from "Direct Method for Determination of Aluminum in Alloys" by I. V. Tananaev and S. T. Abilov. *Zhurnal Prikladnoi Khimii* XV, No. 1–2, 61–70, 1942. (Published in Russia.)

GRAIN SIZE IN TIN ALLOYS

INVESTIGATIONS shows that variations in tensile strength are controlled by the number of grains in the cross-section and not by the absolute grain size. In rolled material, an increase in tensile strength is observed as the number of grains in the cross-section increases from 1 to 20 or 30. Elongations are constant over this range. A further reduction in grain size produces only a slight increase in tensile strength, but elongations increase rapidly. Discontinuity in the relationship between tensile strength and grain size is shown to be caused by the corresponding discontinuity in the extension versus grain size curve, the latter having some fundamental cause. The calculated true stress was found to vary continuously with grain size. With chill-cast specimens, consisting entirely of columnar grains, tensile strengths increase continuously with reduction of grain size, and elongations are either constant or increase only slightly.

Digest from "Grain Size in Tin Alloys," by W. T. Pell-Walpole, *Journal of the Institute of Metals*, Tin Research Institute's Publication No. 118. (Published in Great Britain.)

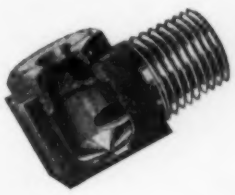
CRESOL-FORMALDEHYDE RESINS

CONDENSATION of formaldehyde with *p*-cresol in presence of hydrochloric acid results in resins, the molecular weight of which increases from 240 to 660 in proportion to the decrease of the molecular ratio of cresol and formaldehyde in the original mixture from 10 to 1.2. These products, being a mixture of compounds having different molecular weights, can thus be separated by fractional precipitation.

These resins belong to the polymer-homologous series of meso-methylene-poly-*p*-cresols. They are characterized by the presence of $(n + 1)$ cresol groups connected with each other through the aromatic nuclei by means of the CH_2 groups. More than one mol of *p*-cresol is bound by one mol of CH_2O, and this increases with an increase in the excess cresol in the initial mixture. However, it does not reach two mols even when the mixture contains 10 mols of *p*-cresol for each mol of the aldehyde. Complete binding of the aldehyde introduced at 100 deg. C is observed only when there is considerable excess of cresol, but it does not occur even after many hours of heating if the proportion of the reagents is approximately equimolecular.

Digest from "Resinous Condensation Products of *p*-Cresol and Formaldehyde," by A. A. Vansheidt, A. T. Itenberg and V. Michailova, *Zhurnal Obshchei Khimii* XII, No. 9–10, 488–499, 1942. (Published in Russia.)

MONARCH CHEMICAL SPRAY NOZZLES *of*



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The Fig. 629 nozzle illustrated is of the "non-clog" type; i.e. it contains no internal vanes, slots, or deflectors which might facilitate clogging.

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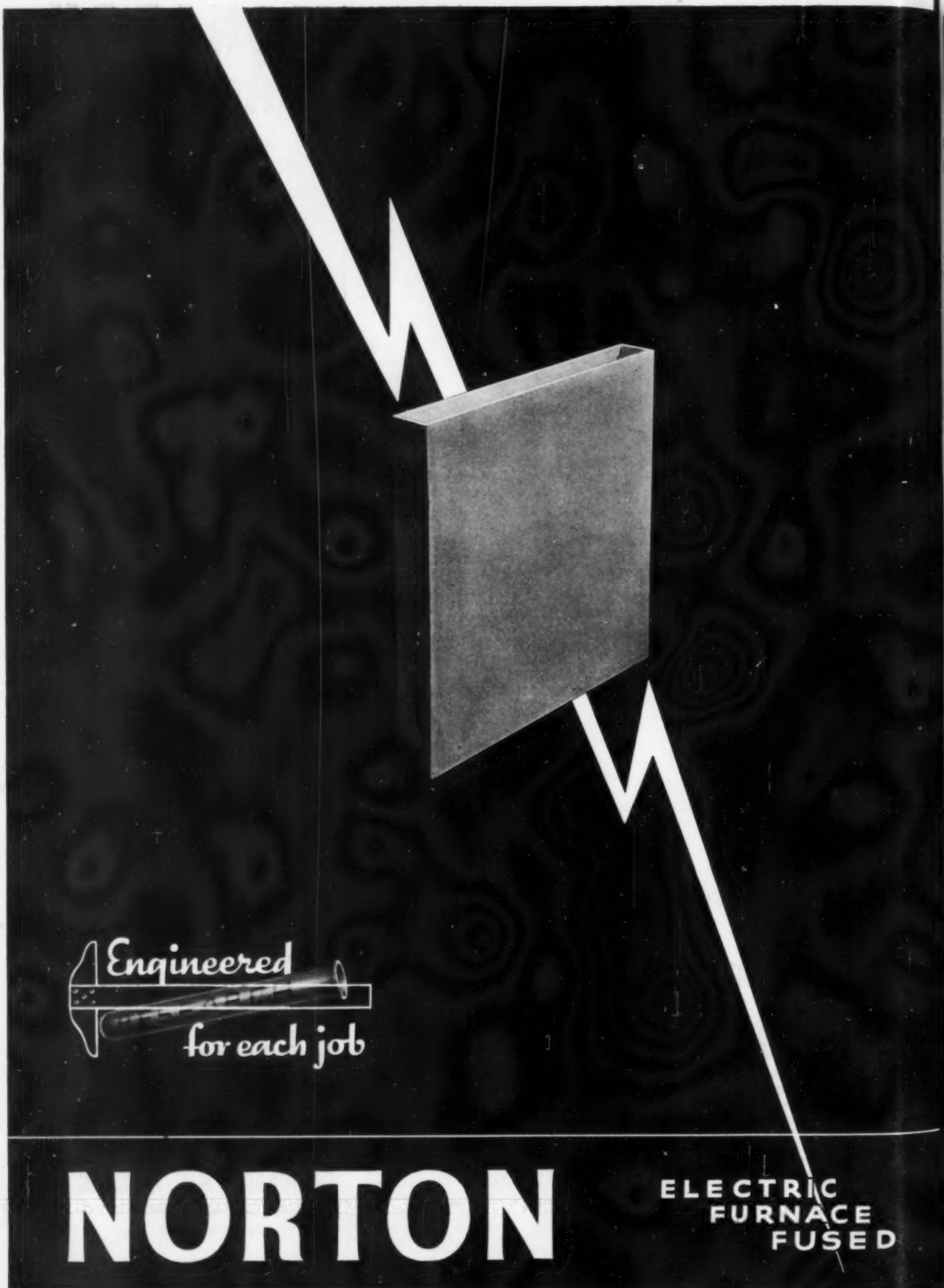
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PLASTICS AND EQUIPMENT

HANDBOOK OF PLASTICS. By *Herbert R. Simonds* and *Carlton Ellis*. Published by D. Van Nostrand Co., New York, N. Y. 1011 pages. Price $10.

Reviewed by *James A. Lee*

Not long before the death of Carlton Ellis, Herbert Simonds and himself, realizing the need in the plastics industry for a handbook of information, set about designing this book to present exhaustively and yet with proper selection the fundamental basis and technology of the industry. The authors intended that the nine parts into which the volume is divided should cover fully the present state of the industry, the physical and chemical properties of plastics, their production, molding and finishing, and all of the useful information which anyone working with plastics should find in a well organized and thorough treatment of the subject.

After Mr. Ellis died, Dr. M. H. Bigelow, technical service director of the Plaskon Co., became co-author. These authors were assisted and guided by an advisory committee.

Part I of the handbook is a history of the industry and is followed by such data as plastic sales, research expenditures, name of plastics for E. I. du Pont de Nemours & Co., Catalin Corp. of America and other companies making plastic materials. This part also includes a list of the molders and the types of moldings produced by each one.

Part II covers properties and methods for measuring the physical properties. This section also contains a group of condensations of commercial catalogs of the leading manufacturers of molding powders and synthetic resins.

Part III treats at length the ingredients of the plastic mix, such as fillers, catalysts, hardeners, solvents, plasticizers and colors. Extensive tables of the properties of solvents and plastics are included. The forms in which the various plastic materials are available is discussed. Synthetic rubber and natural resins are both treated very briefly. Films and coatings are given more consideration.

Part IV on production methods is naturally extremely general. A "box type" flowsheet is given for each of the principal plastics. While the information is not in sufficient detail to serve as a guide for anyone wishing to manufacture the materials, it does give a general idea of the processes. The chapter on equipment should assist anyone wishing to obtain equipment for making or molding plastics.

Part V deals with molding operations.

Part VI covers the chemistry and chemical testing of plastics.

Part VII treats applications of plastics at considerable length.

Part VIII on commercial consideration covers a great variety of subjects that should interest anyone faced with the possibility of entering the manufacture of plastics.

Part IX is a collection of tables of use to plastics engineers, containing also a general glossary, chemical glossary and bibliography.

While most handbooks are a compilation of tables and the like, this one is for the most part a collection of information about plastics and equipment for their manufacture and molding. It is unfortunate that the authors had to depend upon the manufacturers as their sources of information. As a result they were able to present only that information which the manufacturers were willing to have published. While this fact necessarily limits the usefulness of the book it is undoubtedly one of the best books dealing with plastics that has been made available to the engineer and is certainly worth adding to his bookshelf.

IN THE BOLD SPIRIT

THE SPIRIT OF ENTERPRISE. By *Edgar Monsanto Queeny*. Published by Charles Scribner's Sons, New York. 267 pages. Price $2.

Reviewed by *S. D. Kirkpatrick*

My dictionary defines "enterprise" as (1) a project attempted, particularly a bold and hazardous undertaking, (2) readiness in undertakings of difficulty, risk or danger. It must have been in this spirit that Edgar Queeny decided to tilt his lance in defense of business. He has tossed aside the biblical admonition of Job or whoever first said "Would that mine adversary had written a book" and in straight-from-the-shoulder fashion he has dealt some telling blows to the New Deal disciples of Karl Marx, Thorstein Veblen and Stuart Chase. That he has drawn blood is already evident from some of the bitter reviews that have begun to appear in the so-called "liberal" magazines. More can be expected and if I know our author like I think I do, he is going to get a great deal of silent satisfaction in sitting back and watching the melee he has started.

But he will get more satisfaction, I think, if his contemporaries in the chemical industry and profession will spend a few hours in reading his economic philosophy and comparing it with their own. Then, if they are in agreement, perhaps something can be done about eliminating the causes of the worst of our troubles. Elections are coming and there will be plenty of opportunities this year and next to challenge and refute those politicians who would lead us still farther down the path of state socialism. Nor are all the battles to be fought at the polling places. Business has a bigger job to do within its own ranks in promoting a better understanding of its place in our national economy. It must provide a positive philosophy of leadership. It must no longer "take it lying down." It must get up on its hind legs and fight!

All this probably gives an entirely fallacious impression of Mr. Queeny's book. It was not written in the spirit of combat. Rather, the author first sat down and calmly marshalled his arguments against what he calls the New Deal "Hoyle for business." Then realizing that this did not in itself constitute a really valid philosophy of business, he embarked on an ambitious program of study and reappraisal. He spent months in reading Adam Smith, Marx, Veblen, Tugwell, and the tortuous testimony and monographs of the Temporary National Economic Committee—even the current social and postwar planning of Alvin Hansen. Only then was he ready to put down his thoughts in the logical sequence that led to reasoned conclusions and positive recommendations. The book is, in essence, a well documented report on the Queeny process of self instruction and appraisal through which he renewed his faith in the American spirit of enterprise.

This review must not give the reader the impression that the author condemns the New Deal in all its works and without discrimination. He approves of many of its objectives but disapproves of the methods used by their proponents. "But it is not necessary to socialize our economy through central economic planning in order to provide adequately for the so-called lower third." He strongly refutes the T.N.E.C. pretense that our economy has reached maturity. "Payment for a huge social program can be realized from improvements in technology . . . indeed, with our national ingenuity aided by rapidly-advancing science, technological progress should accelerate" our national well-being.

Business, itself, is far from blameless for many of its troubles. "Businessmen," he says, "should be willing to accept more of the classic conception of the free enterprise system. Business should recognize the justice of much well-deserved, though misdirected, criticism by New Dealers. Businessmen should correct the causes of the antipathy to their ways that has arisen in such profound and superb intellects as that of the Archbishop of Canterbury. They should be willing to have all conditions necessary to a free market restored, and to provide the people with the full advantage of competition. They should accept remedies that go all the way in destroying all obstacles to free competition and open markets."

Mr. Queeny well answers those who hold that business lacks a positive program and is unwilling to "stick its

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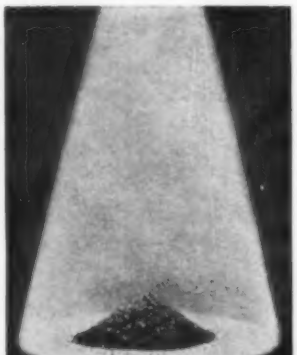

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neck out" with proposals for its self-regulation. Among many constructive suggestions is one for the immediate enactment of a national incorporation law that would prohibit interlocking directorates, mergers between competitors and the ownership of stock in one company by another. Business, he holds, should give up "the special privileges it now enjoys in the way of excessive tariffs." By applying Hatch Act principles to pressure groups, he suggests that "Congress could forbid anyone who receives compensation from more than one individual or enterprise from exercising influence directly or indirectly on any legislation." What better remedy is there for the evils of the lobby and the disproportionately swollen powers of vociferous minorities? "The press should be made to clean its own doorstep, too" if we are to regain the freedom of the press that Thomas Jefferson held so vital in our Bill of Rights. The S.E.C. and the N.L.R.B. should be abolished and Congress should substitute regulatory laws instead of permitting business to be governed by capricious and unpredictable boards and commissions. On the international front, "it would be a boon to the world if utmost competition in all fields were assured by an international law based on the principles of our Sherman and Clayton Acts, outlawing cartels and any other agreements to restrict output or allocate markets."

Such scattered samplings are perhaps enough to show that the author has developed a wholesome philosophy of hope and vision—hope that while we are fighting to preserve the four freedoms for the whole world, we will not surrender the precious freedom of enterprise that has taken us centuries to win; vision that through the progress of science and technology business can achieve all and more than even the rosiest dreams of the social planners. This is the true Spirit of Enterprise—bold, hazardous undertaking spurred on by the incentive of great reward.

RECENT BOOKS and PAMPHLETS

A.S.T.M. Standards on Plastics. Published by the American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa. 371 pages. Price $2. First compilation of A.S.T.M. standards on plastics contains some 71 specifications, test methods, definitions, etc.

Cross-Hauling. Published by the Corporation Trust Co., 120 Broadway, New York, N. Y. 15 pages. Gratis. Offers "spot stocks" as the answer to cross-hauling, and discusses legal aspects of the problem.

Crude Petroleum. Published by United States Tariff Commission for the Office of Price Administration, Washington, D. C. 248 pages. Reports on the cost of producing crude petroleum with detailed statistics by principal pools or fields for 1939, 1940, and the first nine months of 1941; and preliminary summaries for selected pools or fields to June, 1942.

Tests of Composite Timber and Concrete Beams. By *F. E. Richart* and *C. B. Williams, Jr.* Engineering Experiment Station Bulletin Series 343. Published by the University of Illinois, Urbana, Ill. 40 pages. Price 70 cents. Text and results on a form of construction that has come into general use only in the last eight or ten years.

Boiler Feedwater Conditioning and Chemistry. Publication No. 4008 of the Cochrane Corp., Philadelphia, Pa. 32 pages. Describes most common processes used in feedwater conditioning and contains a section devoted to interpretation of water analyses and also tables of formulas, conversion factors, chemical reactions, etc. commonly found in water conditioning practice.

Mineral Wool; Loose, Granulated or Felted Form, in Low-Temperature Installations. Commercial Standard CS105–43. Available from Superintendent of Documents, Washington, D. C. 21 pages. Price 5 cents. A recorded voluntary standard of the trade which covers both cold storage area and pipe-line mineral wool insulation.

Allied's Radio Data Handbook. Edited by *M. M. Cooke.* Published by Allied Radio Corp., Chicago, Ill. 48 pages. Price 25 cents. A condensed collection of formulas, charts and data commonly used in the field of radio and electronics.

Symposium on Radiography. Published by American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa. 256 pages. Price $4. Includes eighteen technical papers presented by outstanding authorities and also proposed recommended A.S.T.M. industrial radiographic terminology.

Manual of Industrial Nutrition. Published by Food Distribution Administration, Nutrition and Food Conservation Branch, U. S. Department of Agriculture, Washington, D. C. 25 pages. This is the first in a series of pamphlets which will be prepared and distributed. Efforts to improve the nutritional status of workers should be directed simultaneously along three lines: Education, provision, and economy.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, express order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for its issue.

The Composition of Paper and Paperboards Manufactured in 1939, By R. V. Reynolds and Albert H. Pierson. Department of Agriculture, Circular No. 668. Price 10 cents.

Wages in Rubber Manufacturing Industry. Bureau of Labor Statistics, Bulletin No. 737. Price 10 cents.

Workers in Subjects Pertaining to Agriculture in Land-Grant Colleges and Experiment Stations, 1942-43. By Betty T. Richardson. Department of Agriculture, Miscellaneous Publication No. 510. Price 25 cents.

Grain Grading. Agricultural War Information documents have been issued by the Department of Agricultural Extension Service as follows: Nine Steps in Grading Soybeans, AWI-35, Ten Steps in Grading Grain Sorghums, AWI-36. Six Steps in Grading Flaxseed, AWI-37.

Union Wages and Hours in the Baking Industry. Bureau of Labor Statistics, Bulletin No. 735. Price 10 cents.

Clay Production Data. A group of preliminary figures on Clay Industries. Distribution of Clay by Uses in 1942. Bentonite Shipments Increased in 1942. Fire Clay Shipments Increased in 1942. Kaolin or China Clay in 1942. The Ball Clay Industry in 1942. Fuller's Earth Output in 1942 Slightly Below 1941.

Mineral Production Statistics for 1942. Preliminary mimeographed Statements from Bureau of Mines on: Magnesite and Magnesium compounds Production Great-

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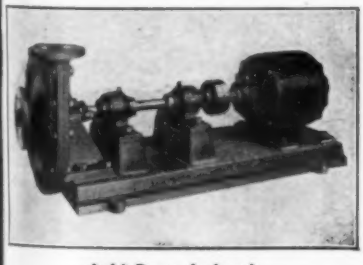

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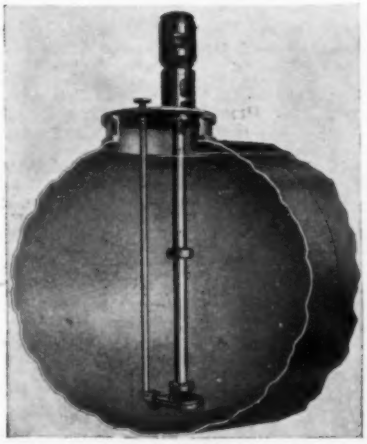

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er in 1942. Crushed and Broken Stone in 1942. Total Value of Abrasive Materials Produced in 1942 Rises Sharply. Native Sulfur in May, 1943. Pennsylvania Anthracite in 1942. Fuel Briquets and Packaged Fuel in 1942. Feldspar Production in 1942 Higher Than Any Other Year Except 1941. Nitrogen Compounds in 1942. Sulfur and Pyrites in 1942. Active Market in Liquefied Petroleum Gases in 1942.

Briquetting Subbituminous Coal. By V. F. Parry and J. B. Goodman. Bureau of Mines, Report of Investigations R. I. 3707. Mimeographed.

Damage from Air Blast. By S. L. Windes. Bureau of Mines, Report of Investigations R. I. 3708. Mimeographed.

Determination of Tungsten in Low-Grade Ores. By H. E. Peterson and W. L. Anderson. Bureau of Mines, Report of Investigations R. I. 3709. Mimeographed.

Explosion Hazards of Combustible Anesthetics. By G. W. Jones and others. Bureau of Mines, Technical Paper No. 653. Price 15 cents.

Syllabus of Clay Testing, Part I. By Theron A. Klinefelter and others. Bureau of Mines, Bulletin 451. Price 15 cents.

Census of Manufacturers. Volume I. "Statistics by Subjects". A portion of the report on data for industry operations in 1939. Price $1.75, clothbound.

Methods of Analysis and of Reporting Fiber Composition of Textile Products. Bureau of Standards, Commercial Standard CS65-43. Price 5 cents.

Gages: Dimensional. Bureau of Standards, Letter Circular LC 723. List of publications by the staff of the Bureau of Standards. Mimeographed.

Quality Classification and Inspection of Precision Gage Blocks. Bureau of Standards, Letter Circular LC 725. Mimeographed.

Some Notes on Standardization, With Particular Reference to Retail Package Sizes. Bureau of Standards, Letter Circular LC 726. Mimeographed.

Experimental Dry-Wall Construction With Fiber Insulating Board. By Charles G. Weber and Robert C. Reichel. Bureau of Standards, Building Materials and Structure Report BMS97. Price 10 cents.

Industrial Manganese Poisoning. By Lawrence T. Fairhall, and Paul A. Neal. U. S. Public Health Service, National Institute of Health Bulletin No. 182. Price 10 cents.

Supplemental Report on the Cost of Producing Crude Petroleum. With statistics for selected pools or fields outside of California and certain Eastern States for 1939, 1940, 1941, and January-July 1942. Tariff Commission unnumbered document. Mimeographed.

Supplemental Report on the Cost of Producing Crude Petroleum in California. With detailed statistics, by selected pools or fields, for 1939, 1940, 1941, and the first seven months of 1942. Tariff Commission unnumbered document. Mimeographed.

Ground Water Supply. Two of the series of U. S. Geological Survey Water-Supply Papers giving water levels and artesian well pressures are: For Northeastern States, Water Supply Paper 936; price 35 cents. for South-Central States, Water Supply Paper 939. Price 30 cents.

Geology and Ore Deposits of the Magdalena Mining District, New Mexico. By G. F. Loughlin and A. H. Koschmann. U. S. Geological Survey, Professional Paper 200. Price $2.00.

Antimony Deposits of The Stampede Creed Area, Kantishna District, Alaska. By D. E. White. U. S. Geological Survey, Bulletin 936-N. Price 25 cents.

The Rose Creek Tungsten Mine, Perishing County. By R. J. Roberts. U. S. Geological Survey, Bulletin 940-A. Price 30 cents.

Tin Deposits of the Republic of Mexico. By William F. Foshag and Carl Fries, Jr. U. S. Geological Survey, Bulletin 935-C. Price 40 cents.

Geology and Ore Deposits of the Metaline Quadrangle, Washington. By C. F. Park, Jr. and R. S. Cannon, Jr. U. S. Geological Survey, Professional Paper 202. Price $1.50.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog on the following items: Acid, Nitric; Technical Grade, O-A-88, price 5 cents. Oil; Linseed-Replacement (for Thinning Paints and Pastes in Oil), TT-O-371, price 5 cents. Paper; Kraft, Wrapping, Waterproofed, UU-P-271a, price 5 cents.

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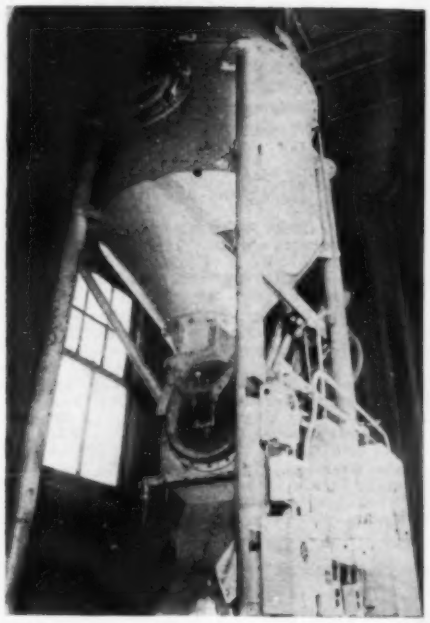

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Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Turbines. DeLaval Steam Turbine Co., Trenton, N. J.—Four-page reprint entitled "Adapting an Auxiliary Turbine for Higher Pressure." Illustrated with photographic reproductions and schematic diagrams.

Control Instruments. The Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa.—Bulletin 871—Six-page booklet on this concern's "New-Matic" Time-Pattern Controller. Describes operating principles of the transmitter and the control instrument and deals with application and advantages. Supplemented with diagrams and illustrations of installations.

Infra-Red Burner. Burdette Manufacturing Co., 19 North Loomis St., Chicago, Ill.—16-page catalog which illustrates and describes this concern's infra-red principle in gas burners for utilizing 99 percent infra-red ray radiation. Describes advantages of this method of applying heat, describes the principles of operation, outstanding advantages, conversion of old equipment. Includes data on typical burner installations for paint drying, food processing, etc. Extensively illustrated by photographic reproductions and diagrammatic drawings.

Metal Cleaning. American Chemical Paint Co., Ambler, Pa.—Sheet P-1002—Four-page form describing and giving outstanding advantages of this concern's "Deoxidine No. 170" for removing light oil, annealing scale and eradicating rust. Lists other products of the concern.

Print Making. Paragon-Revolute Corp., 77 South Ave., Rochester, N. Y.—42 -page handbook dealing with this concern's various processes for print making and processing, including blueprints, sepia negatives, direct process prints, reproduced tracings, continuous yardage and cut sheets. Describes and illustrates the various machines and processes, gives outstanding features and advantages of each, and includes extensive tables on specifications. Well illustrated.

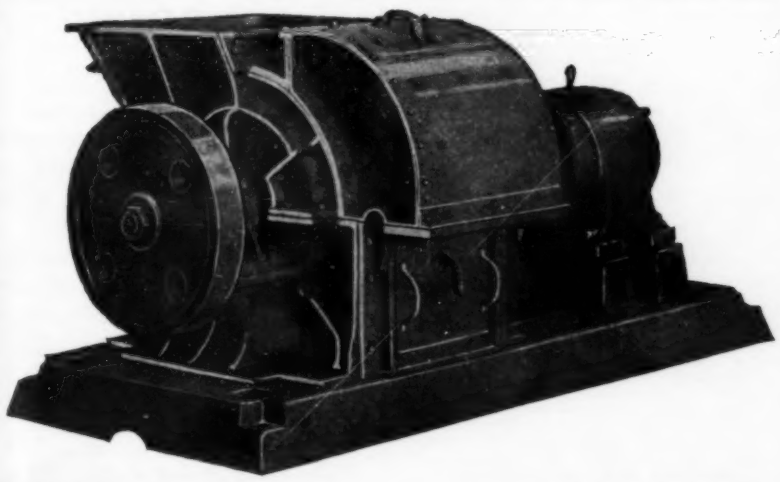
Ovens. The Industrial Oven Engineering Co., Granada Bldg., Detroit Ave. at West 117th St., Cleveland, Ohio.—18-page booklet entitled "Blueprint for Industry," which gives engineering information on high-production convection heated ovens for batch and continuous heating processes for armament production. Each type of equipment is illustrated by a diagrammatic drawing and described briefly. Contains extensive engineering data.

Ventilation. Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago, Ill. —Form 516—32-page booklet giving typical cases of heating, ventilating and cooling problems, but written in detective-story style and illustrated with amusing sketches.

Joints. Brooks Equipment Corp., 90 West St., New York, N. Y.—New catalog and handbook on remote control, universal joints, shaft joints, shaft couplings, steering controls, etc. Describes two new joints, one which operates effectively at angles from zero deg. to 360 deg. in any plane, and the other with positive and effective operating range at angles from zero to 92 deg. in any one plane. Contains data sheets and blueprints of the joints and assemblies.

Pumps. Ingersoll-Rand Co., 11 Broadway, New York, N. Y.—Form 7073—Booklet on vertical axial and mixed-flow pumps for pumping large volumes of liquid at comparatively low heads. Includes cross-sectional views showing features of design and construction. Well illustrated.

Refractories. Laclede-Christy Clay Pro-



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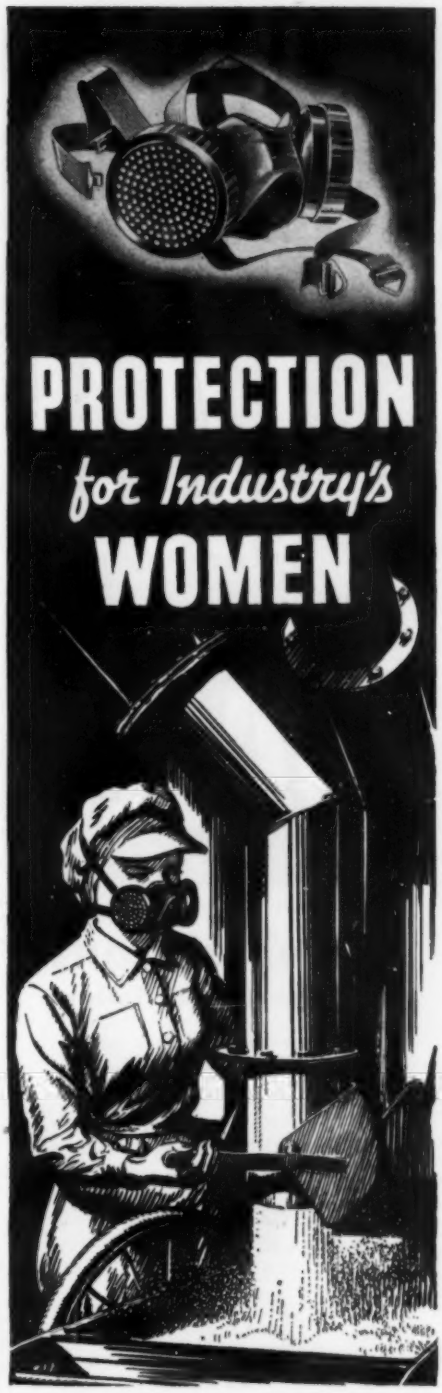

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ducts Co., St. Louis, Mo.—Six-page chart giving engineering information and uses on this concern's complete line of refractories and refractory specialties. Includes data on high-temperature cements, coatings, plastics, fire brick and insulating fire brick.

Degreasers. Technical Processes Division, Colonial Alloys Co., Colonial Philadelphia Building, Philadelphia, Pa.—Form 115431—Describes uses of the four available types of "Cyclodiene" base hydrocarbon solvent degreasers and cleaners for metals put out by this concern. Also deals with painting or lacquering on the wet surface immediately after work comes out of the bath.

Surface Condensers. Ingersoll-Rand Co., 11 Broadway, New York, N. Y.—36-page booklet on surface condensers put out by this concern. Discusses structural and design features, steam penetration, cross-flow condensers, etc. Includes many illustrations of typical condenser installations. Contains technical information.

Wood Preservation. I. F. Laucks, Inc., Seattle, Wash.—Eight-page brochure on this concern's complete series of low-cost wood treatments for plant application, including water-repellant toxic preservatives. Describes method of treatment with a chart showing applications and needs for different types of preservatives. Illustrated.

Thermosetting Spreader Coating. Plastics Division, Carbide & Carbon Chemical Corp. 30 East 42nd St., New York, N. Y.—Six-page folder entitled "Thermosetting Vinyl Butyral Spreader Coatings" which contains data on formulation, primer coating, pigments, plasticizers, etc. Stresses use of these resins for waterproofing floor coatings to replace rubber.

Polyvinyl Alcohol. Electrochemicals Dept., E. I. du Pont de Nemours & Co., Wilmington, Del.—Booklet 2243—Describes the molding of elastic articles with rubber-like properties from plasticized polyvinyl alcohol. These resins are unaffected by oils, fats, greases and common organic solvents and may be prepared for molding or extrusion in conventional rubber and plastic equipment. Includes information on plasticizers, preparation of the molding composition, and other properties of the resins.

Wood Glues. Casein Co. of America, 350 Madison Ave., New York, N. Y.—14-page booklet dealing with the application of casein-derived glues for wood in war purposes. Deals with applications in marine equipment, wood transport equipment, Army hutments, wood field furniture, structural members, industrial equipment, weatherproof fibre shipping cases, etc. Extensively illustrated.

Fractionating Towers. Ten-page reprint entitled "Design and Construction of a 33-ft. Diameter Arc-Welded Vacuum Fractionating Tower." From the Industrial Progress Award Program Paper of the James F. Lincoln Arc Welding Foundation. Contains extensive engineering data and calculations in text form, diagrammatic sketches and charts.

Driers. B. F. Sturtevant Co., Hyde Park, Boston, Mass.—Catalog 461—26-page booklet on the line of industrial driers and drying systems put out by this concern. Contains data of general interest, goes into fundametantal drying principles, and describes various types of drying processes and apparatus used to effect them, together with a description of the design of systems used in certain specialized drying applications. Well illustrated.

Electrode Stub Control. James F. Lincoln Arc Welding Foundation, Cleveland, Ohio—Six-page reprint entitled, "A Simple Plan for Electrode Stub Control." Contains illustrations and estimates on cost of installation and operation.

Control Instruments. Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.—Bulletin Z6200—16-page bulletin on the line of measuring and control instruments put out by this concern. Each unit is illustrated and described briefly. Contains prices and specifications.

Brazing. Handy & Harman, 82 Fulton St., New York, N. Y.—Four-page form dealing with the design for fast, low-cost metal joining with low-temperature "Sil-Fos" and "Easy-Flo" brazing. Extensively illustrated with photographic re-

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Visual Inspection. Larrimore Sales Co., P. O. Box 1234, St. Louis, Mo.—Two-page form dealing with visual inspection with this concern's two-tube day-lighting fluorescent and double-magnifying lens. Includes prices. Illustrated.

Terminators. Delta Star Electric Co., 2400 Block, Fulton Street, Chicago, Ill.—Publication 4303—four-page folder dealing with this concern's unit type "PB" terminators for industrial and control cables. Contains illustration and technical data.

Sheaves. Worthington Pump Machinery Corp., Harrison, N. J.—Form V1400 7C—16-page booklet on the line of sheaves for driver and driven units put out by this concern. Contains extensive diagrammatic drawings, specification data and information on sheaves.

Bearings. Miniature Precision Bearings, Keene, N. H.—Form 43—Four-page form illustrating and describing briefly the line of miniature precision bearings of radial and pivot series put out by this concern. Contains data on specifications.

Plastic Tubing. Elmer E. Mills Corp., 812 W. Van Buren St., Chicago, Ill.—Six-page form dealing with this concern's line of plastic tubing and fittings. Includes technical data and physical properties, as well as information on industrial applications. Illustrated.

Sealants. Babbitt Industrial Specialties Co., International Building, 45 Rockefeller Plaza, New York, N. Y.—Twelve-page booklet entitled "The Story of Sealants." Includes data on recommended sealants, application of this concern's plastic sealant for various jobs, a visual demonstration of workability of Babbitt sealant, and data on industrial uses.

Arc Welding. The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio—Six-page reprint entitled "Arc Welding Tool Steel With Stainless Electrodes." Extensively illustrated with photographic reproductions and diagrammatic drawings.

Centrifugals. The Sharples Corp., 2300 Westmoreland St., Philadelphia, Pa.—Bulletin 1229—Eight-page bulletin on this concern's centrifuges with self-cleaning rotors, the Nozejector and Autojector type, showing principles, specifications and typical applications of each type.

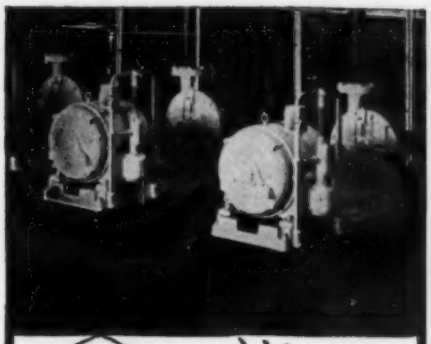
Manganese Steel. American Manganese Steel Div., American Brake Shoe Co., Chicago, Ill.—Bulletin 543G—46-page booklet on this concern's manganese steel for general industrial purposes. Illustrates and describes briefly various applications in process industries, foundries, gas and coke plants, glass industry, paper mills, sugar mills, etc. Includes data on properties of manganese steel. Extensively illustrated.

Vitamins. Vitamins Industrial, Inc., 222 N. Bank Drive, Chicago, Ill.—Twelve-page reprint entitled "Vitamins for War Workers." Describes the role of vitamins in maintaining morale and health of industrial war workers. Presents a plan for distribution of vitamins to workers. Also a two-page reprint illustrating and describing actual tests at an aircraft plant showing differences between production with workers having vitamins and those without vitamins.

Motors. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Form 344A—16-page booklet illustrating and describing this concern's line of squirrel-cage induction polyphase motors of 1/6 to 600-hp. capacity. Discusses methods of how to select the ones best suited for various applications.

Resinates. Hercules Powder Co., Wilmington, Del.—Form 19—Four-page form entitled "Soluble Oils With Dresinate." Describes the value of this line of water-soluble resinates for emulsifiers used in soluble oil. Physical properties, advantages, formulation procedure and specific directions. Illustrated.

Wire Enameling. General Electric Co., Schenectady, N. Y.—Form GEA-4017—Eight-page booklet dealing with wire-enameling systems in six different sizes to handle wire from 8 to 50 gage.



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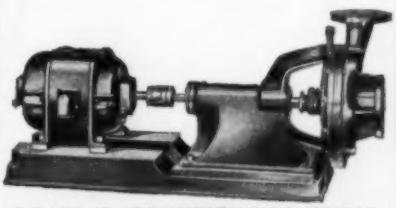

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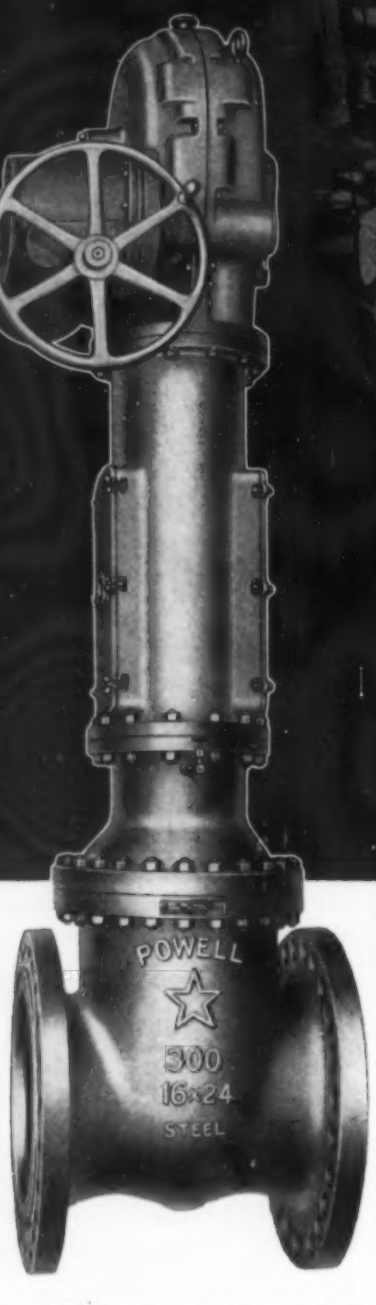

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ECONOMICS AND MARKETS

PRODUCTION OF CHEMICALS CONTINUES TO RISE WITH CONSUMPTION HOLDING A FAIR BALANCE

THE adjusted index for industrial production as reported by the Federal Reserve Board is preliminarily placed at 201 which represents a drop from the peak of 203 which was reported for April and May. The *Chem. & Met.* index for industrial consumption of chemicals for June is 173.68 which compares with 179.58 for the preceding month and with 166.56 for June 1942. The Federal Reserve Board moved its index number for production of chemicals from 221 in May to a new high of 228 for June. Production of munitions—which includes most products going directly into the war program—was represented by the number 580 as compared with 563 for both April and May. The movement of these different indexes gives some verification to the report that production of civilian goods is declining while that for war goods is increasing. As a matter of fact it has been stated in official circles that a rather sharp drop in civilian-goods output must be made over the remainder of this year and a marked increase made in the volume of war goods turned out in the same time.

So far as the industries which are included in the *Chem. & Met.* index are concerned, it is probable that no marked change from current levels will take place. A large part of the goods made in these industries is classed as essential and hence will not come under restrictive measures. However, all of the industries are not in the same position. Pulp and paper production, for instance, is now under a further curtailment program and activities at mills will reflect this in the ensuing months. Coke plants apparently were not greatly affected by the stoppage at coal mines as production of ammonia at byproduct plants in May was 5,853,589 lb. and 5,588,850 lb. in June. For the same months production of ammonium sulphate was 64,402 tons and 60,144 tons respectively.

Sales of soap, based on reports from manufacturers representing about 90 percent of total production, fell off in the second quarter of this year. In the Jan.-March quarter, sales were reported at 713,000,000 lb. and for the April-June quarter, the total was given at 656,362,787 lb. For the first half of this year sales are placed at 1,369,806,176 lb. as against 1,497,000,000 lb. for the corresponding period of last year. These figures do not include liquid soap and while the second quarter showing was not so good, the volume of sales was above that for the second quarter of 1942 and also above the five-year average for the quarter.

In connection with over-all production at war plants, it might be expected that some dropping off would follow the closing of some works where the outputs no longer were needed. This point, however, was covered in a report from WPB which stated that war plants whose production programs were cut back a few months ago are rapidly taking their places again on the war production battle-line. They are being used to break bottlenecks that have perilled deliveries of important fighting weapons.

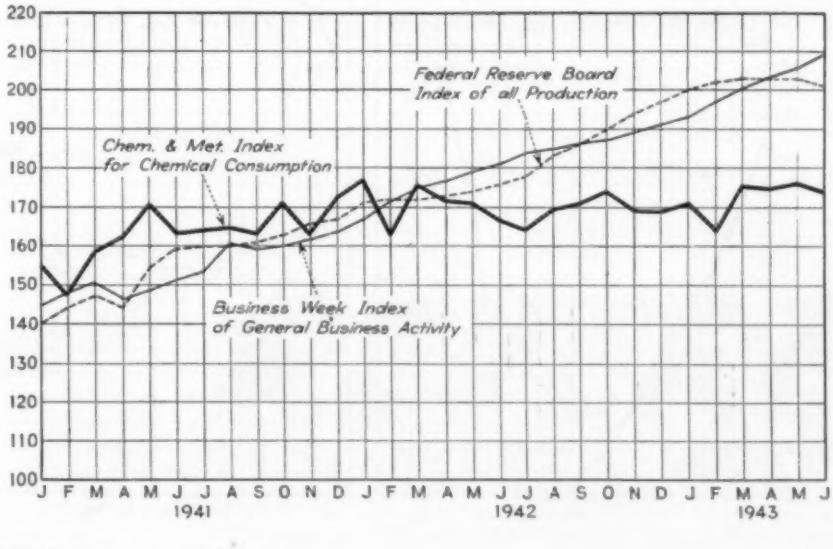
As the fertilizer program has unfolded, it is apparent that potash supplies will not be as large as desired but plentiful stocks of superphosphate and ammonia are in sight. Unfortunately, more of the available ammonia will be in the form of liquid ammonia and ammonia liquors and also there will be a surplus of ammonium nitrate above the desire of the industry. That rather deliquescent chemical is to be used in fertilizer to the maximum extent because military explosives demand has been reduced by generous supplies of TNT. Difficulties have been experienced in handling and storing this nitrate but most of these difficulties have been overcome.

Chem. & Met. Index for Industrial Consumption of Chemicals

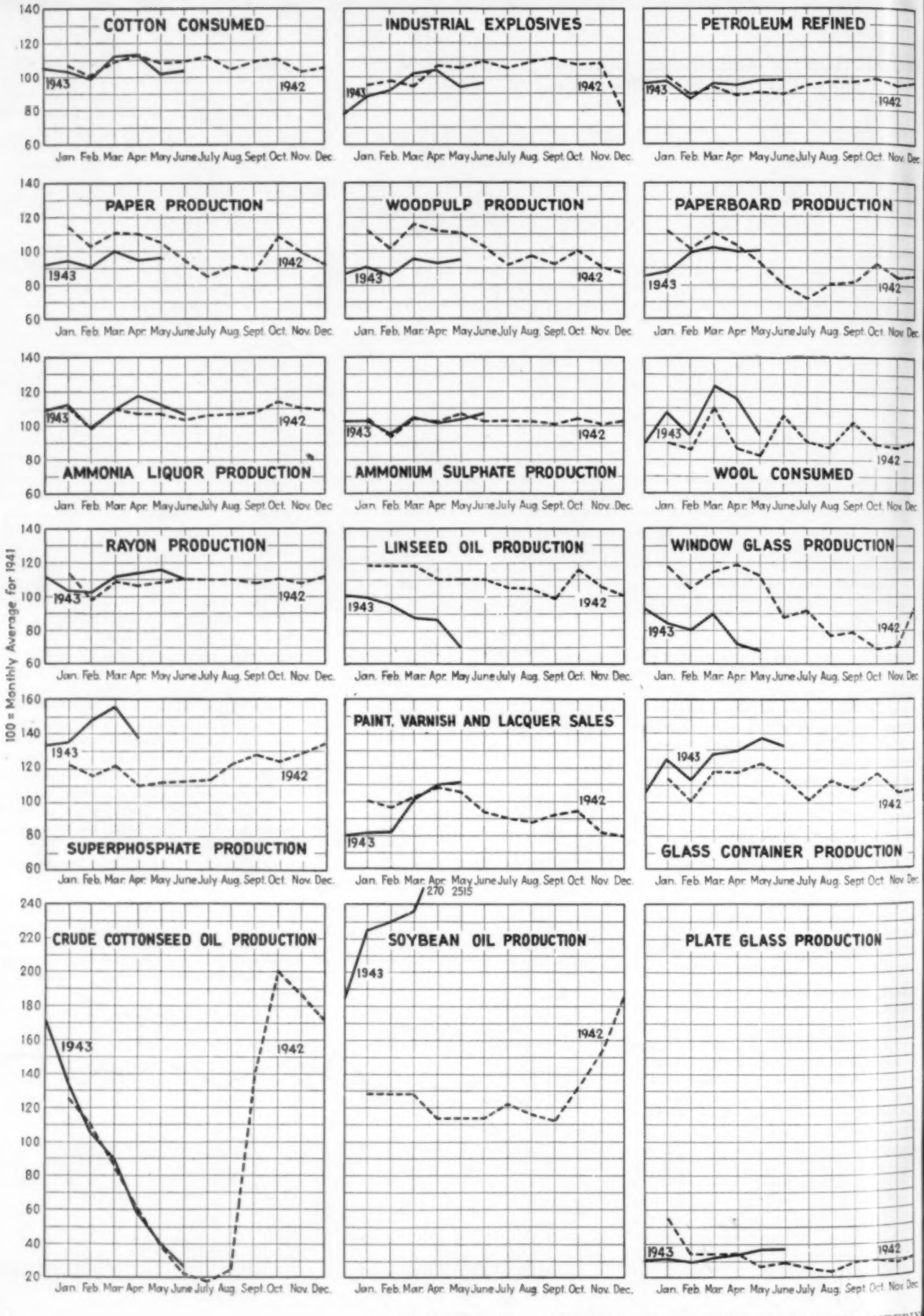
	May revised	June
Fertilizers	40.06	39.50
Pulp and paper	19.98	18.80
Petroleum refining	15.07	15.12
Glass	19.30	18.73
Paint and varnish	16.60	15.00
Iron and steel	13.84	13.14
Rayon	15.92	15.17
Textiles	11.47	11.57
Coal products	9.61	8.97
Leather	4.65	4.55
Industrial explosives	5.28	5.38
Rubber	3.00	3.00
Plastics	4.80	4.75
	179.58	173.68

The supply of potash chemicals available during the coming fertilizer year will include 700,000 tons of K_2O. Of this total 540,000 tons will be used for domestic agriculture (including Hawaii and Puerto Rico); and 85,000 tons for industrial and chemical uses. The balance of 75,000 tons will go to Canada, the United Kingdom, and to a small extent for Latin American customers. Under these circumstances, the farmers are not going to get quite as much potash as they would like. There will not be even as much potash as necessary to maintain the normal ratio between potash and nitrogen or phosphate. Modification of formulas to economize on potash is therefore sought generally. Also the industry has asked for larger imports of nitrate of soda.

Production of soap has been adversely affected by restrictions placed on the movement of important raw materials. Preference for tallow and greases is given to contractors who require these fats for government orders. It is estimated that from 25 to 35 percent of these raw materials will be so restricted under Food Distribution order No. 67 which became effective at the beginning of the month. Soap manufacturers, normally the largest consumers, cannot get special authorization but probably will get between one-half and two-thirds of the total supplies anyway, after war industry allocations have been met. Despite this restriction it is expected that current soap production will be maintained. Recently released quantities of crude soybean, palm, and coconut oils are expected to augment present stocks of soap makers. Definite plans made some time ago for rationing soap have been canceled as apparently improved ocean transport conditions insure more adequate supplies of oils and fats.



Production and Consumption Trends



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NEW MAXIMUM PRICES ESTABLISHED FOR CHEMICALS AND PRESSED FISH OILS

CHANGES in price regulations again formed the most important market development of the past month. The proposal to place sales of butyl alcohol on an adjustable price basis met with such opposition that it was replaced by the establishment of new maximum prices for grain fermentation butyl alcohol based on an average cost of $1.22 a bushel for grain. For each fluctuation of 7c. a bushel in the price of grain, the butyl alcohol ceilings are to be adjusted at the rate of 1c. a lb. The new ceilings were made specific for the three fermentation producers. A maximum of 18.8c. a lb. for grain butyl alcohol and 17.95c. a lb. for grain butyl acetate is fixed for the production of the Commercial Solvents Corp. On the same average cost per bushel of grain, the maximums for the U. S. Industrial Chemicals, Inc., and the Publicker Commercial Alcohol Co. are 22.6c. a lb. for butyl alcohol and 21.15c. a lb. for butyl acetate. Revised ceilings also were named for these products when made from molasses, the new highs being 18.5c. a lb. for alcohol and 18c. a lb. for acetate. All above quotations are for eastern delivery in tankcars.

Later on dibutyl phthalate came under a sliding scale of maximum prices based on each producer's average monthly costs for butyl alcohol. The base price was fixed at 19½c. a lb. for tankcars, fob works, when the butyl alcohol cost is figured at 15c. a lb. For carlots, in drums the maximum is 20½c. a lb. For each 1c. a lb. change in the cost of butyl alcohol, a change of .0057c. a lb. is made in the price for dibutyl phthalate.

There is a large movement of chemicals to outside countries. A good part of this is accounted for by lend-lease activities but in addition there is an active export inquiry in the open market—usually an inquiry more active than can be taken care of by the limited amount of chemical offerings. Licenses for export to Argentina were revoked last month. This applied to all individual licenses issued prior to May 1. Holders of the revoked licenses were instructed to submit them to the Office of Exports at Washington for revalidation. The action is reported to have been made with the approval of Argentine authorities and was carried out in order to make certain that shipments clearing for the Argentine were going to satisfactory consignees.

For some time, one of the most serious problems connected with the marketing of chemicals has been concerned with packaging the products. In the first place there has been a very heavy movement of packaged goods to points outside the country. A good part of this movement was for our military needs with lend-lease accounting for a sizeable amount. Deliveries on domestic account also have run above normal and in consequence, an abnormal call for packages of different types has been experienced. Production of heavy types of steel barrels and drums has run about 10 percent below the rate of last year and production of the light types has been less than one-half the 1942 rate. As different packaging materials became scarce, attempts have been made to shift to something in fuller supply but this shifting demand quickly created shortages in the substitute materials. The situation has become so grave that the Containers Division of WPB is enlisting industry support in a movement to find ways to use shipping containers more than once with suggestions for careful handling, opening and re-using every container.

While the big squeeze in packaging mostly affects the less carlot business and particularly that part of it which applies to civilian requirements, the tankcar situation is none too favorable. ODT has issued a list of about 250 chemical products which may be shipped in tanks, banning such shipment for chemicals not on the list. An order also was issued requiring that tankcars be loaded to certain standards of capacity.

Linseed oil attracts much attention. In the first place there has been no change in the supply situation and despite the fact that the seed supply for the coming season promises to be the largest on record, this has no bearing on the current market where stocks of oil are small and where government regulations direct a good part of distribution. In the present month crushers are required to reserve 45 percent of their production subject to government call. Last month it was announced that priority ratings for the purchase of linseed oil would be issued to manufacturers filling military and lend-lease contracts. But such priorities were to be granted only where a small list of specified products entered into the contracts.

Production of crude glycerine in the first half of this year has been running about 20 percent below the rate maintained in the first half of 1942. Consumption fell off to a slightly higher extent under the controls which regulated distribution. Recently production has been a little larger than consumption with a moderate gain in stocks. Allocations, however, are expected to continue along present lines unless continued large arrivals of oils are assured. In the meantime the market is firm and there is nothing in the immediate situation to point to a marked change either in supply or price modification.

With vegetable oils in a strong statistical position, the fish oil industry is being called upon to extend its operations as much as possible. On the first of the month the Pacific Coast pilchard fishing season got underway. More than a billion pounds of pilchards are needed this year to meet the minimum demands of the war program for canned fish, animal feeding meals and fish oils. Considerable progress has been reported for the season to date as concerns production of menhaden oil in eastern and southern centers.

Maximum prices for pressed fish oil delivered in tankcars have been increased by official order. The new highs are 11.25c. a lb. for crude whale oil, No. 1, fob. ports; 7.75c. a lb. for crude sperm oil; 8.90c. a lb. for crude sardine oil, fob. Pacific Coast works; 8.90c. a lb. for crude menhaden oil, fob. producers plant; and the same figure for crude herring oil fob. Seattle.

There have been serious declines in both pulpwood and wood pulp production and inventories during the first six months of 1943, the Pulp and Paper Division of WPB has pointed out. Pulpwood receipts during the six months ending June 30, 1943, dropped 24 percent when compared with the first half of 1942, and pulpwood inventories as of June 30, 1943, were 32 percent below the level of June 30, 1942. Total receipts of pulpwood during the first half of 1942 totaled 8,708,973 cords compared with only 6,609,095 cords during the first six months of this year. Inventories of pulpwood as of June 30, 1942, totaled 3,428,590 cords, whereas on June 30, 1943, the inventory of pulpwood was down to 2,324,375 cords.

In the same comparative periods, wood pulp production declined nearly 17 percent and wood pulp inventories dropped 25 percent. Wood pulp production during the first half of 1942 amounted to 5,601,432 tons, but dropped during the first half of this year to 4,653,270 tons. Inventories of wood pulp as of June 30, 1942, totaled 864,333 tons compared to a total of 674,449 tons on June 30, 1943.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base=100 for 1937

This month	**109.03**
Last month	109.03
August, 1942	109.11
August, 1941	102.91

Adjustable price basis for butyl alcohol and acetate has been succeeded by established price ceilings which may be varied to conform with variations in the cost of grains. Gum rosins have had a marked price rise.

CHEM. & MET. *Weighted Index of Prices for* OILS & FATS

Base=100 for 1937

This month	**145.55**
Last month	145.55
August, 1942	141.53
August, 1941	122.80

Maximum prices for pressed fish oils have been amended by placing specific ceilings for the various types of oil. Stocks of linseed oils remain small and ceiling prices are maintained in transactions. Corn oil firmly held.

CURRENT PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.085–$0.109	$0.085–$0.109	$0.168–$0.173
Acid, acetic, 28%, bbl., cwt.	3.38 – 3.63	3.38 – 3.63	3.38 – 3.63
Glacial 99.5%, drums	9.15 – 9.40	9.15 – 9.40	9.15 – 9.40
U.S. P. X 1, 99.5%, dr.	10.95 –11.20	0.95 –11.20	10.95 –11.20
Boric, bbl., ton	109.00–113.00	109.00–113.00	109.00–113.00
Citric, kegs, lb.	.20 – .23	.20 – .23	.20 – .23
Formic, cbys, lb.	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb.	1.10 – 1.15	1.10 – 1.15	1.10 – 1.15
Hydrofluoric 30% drums, lb.	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb.	.073– .075	.073– .075	.073– .075
Muriatic 18°, tanks, cwt.	1.05 –	1.05 –	1.05 –
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –20.00	18.50 –20.00
Oxalic, crystals, bbl., lb.	.11½– .13	.11½– .13	.11½– .13
Phosphoric, tech., c'bys., lb.	.07½– .08¼	.07½– .08¼	.07½– 08¼
Sulphuric, 60°, tanks, ton	13.00 –	13.00 –	13.00 –
Sulphuric, 66°, tanks, ton	16.50 –	16.50 –	16.50 –
Tannic, tech., bbl., lb.	.71 – .73	.71 – .73	.71 – .73
Tartaric, powd., bbl., lb.	.70 –	.70 –	.70 –
Tungstic, bbl., lb.	nom	nom	nom
Alcohol, amyl	–	–	–
From Pentane, tanks, lb.	.13½–	.13½–	.13½–
Alcohol, Butyl, tanks, lb.	.10½– .18½	.10½– .19	.158–
Alcohol, Ethyl, 190 p'f., bbl., gal.	11.94 –	11.94 –	8.19 – 8.25
Denatured, 190 proof	–	–	–
No. 1 special, dr., gal. wks.	.62 –	.62 –	.60 –
Alum, ammonia, lump, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb.	.04¼– .04½	.04¼– .04½	.04 – .04½
Aluminum sulphate, com. bags, cwt.	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt.	1.85 – 2.10	1.85 – 2.10	1.85 – 2.10
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02 – .02½	.02 – .02½	.02 – .02½
Ammonia, anhydrous, cyl., lb.	.16 –	.16 –	.16 –
tanks, lb.	.04½–	.04½–	.04½–
Ammonium carbonate,powd.tech., casks, lb.	.09½– .12	.09½– .12	.09½– .12
Sulphate, wks., ton	29.20 –	29.20 –	29.00 –
Amylacetate tech., from pentane, tanks, lb.	.145–	.145–	.145–
Antimony Oxide, bbl., lb.	.15 –	.15 –	.15 –
Arsenic, white, powd., bbl., lb.	.04 – .04½	.04 – .04½	.04 – .04½
Red, powd., kegs, lb.	nom	nom	nom
Barium carbonate, bbl., ton	60.00 –65.00	60.00 –65.00	60.00 –65.00
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb.	.11 – .12	.11 – .12	.10½– .11
Blanc fix, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.25 – 2.35	2.25 – 2.35	2.25 – 2.35
Borax, gran., bags, ton	44.00 –	44.00 –	44.00 –
Bromine, cs., lb.	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –	3.00 –	3.00 –
Arsenate, dr., lb.	.07 – .08	.07 – .08	.07 – .08
Carbide drums, lb.	.04½– .05	.04½– .05	.04½– .05
Chloride, fused, dr., del., ton	18.00 –24.00	18.00 –24.00	18.00 –24.00
flake, bags., del., ton	18.50 –25.00	18.50 –25.00	18.50 –25.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½–	.05½	.05½–
Tetrachloride drums, gal.	.73 – .80	.73 – .80	.73 – .80
Chlorine,liquid,tanks, wks., 100 lb.	2.00 –	2.00 –	2.00 –
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b., wks., ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb.	.19½– .20	.19½– .20	.18 – .20
Sulphate, bbl., cwt.	5.00 – 5.50	5.00 – 5.50	5.15 – 5.40
Cream of tartar, bbl., lb.	.57 –	.57 –	.57 –
Diethylene glycol, dr., lb.	.14 – .15½	.14 – .15½	.14 – .15½
Epsom salt, dom., tech., bbl., cwt.	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Ethyl acetate, drums, lb.	.12½–	.12½–	.12 –
Formaldehyde, 40%, bbl., lb.	.05½– .06	.05½– .06¼	.05½– .06
Furfural, tanks, lb.	.09 –	.09 –	.09 –
Fuel oil, drums, lb.	.18 – .19	.18 – .19	.18 – .19
Glauber's salt, bags, cwt.	1.05 – 1.10	1.05 – 1.10	1.05 – 1.10
Glycerine, c.p., drums, extra, lb.	.18½–	.18½–	.18½–

The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to August 13

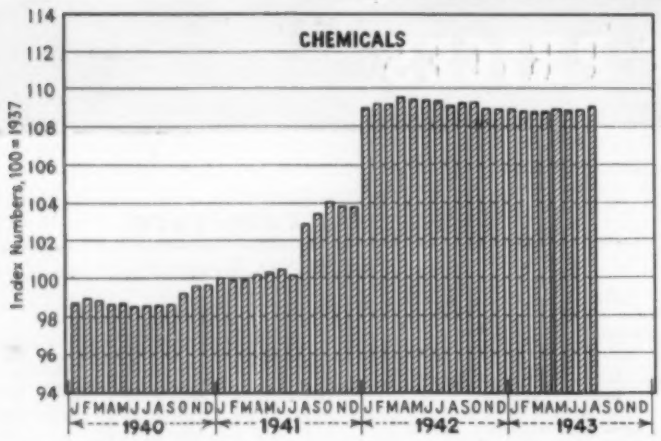
INDUSTRIAL CHEMICALS

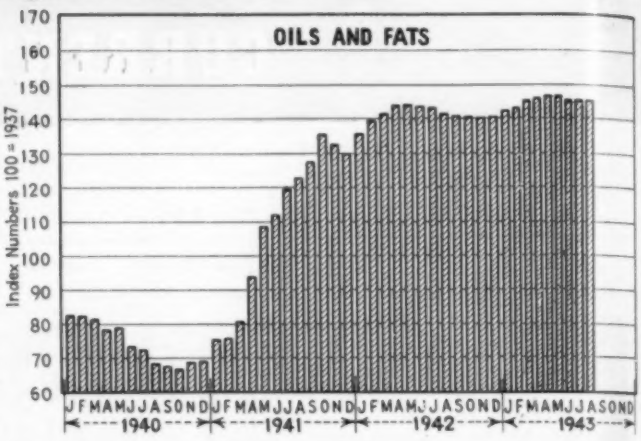
	Current Price	Last Month	Last Year
Lead:			
White, basic carbonate, dry casks, lb.	.08½–	.08½–	.08½–
White, basic sulphate, sck., lb.	.07½–	.07½–	.07½–
Red, dry, sck., lb.	.09½–	.09½–	.09½–
Lead acetate, white crys., bbl., lb	.12½– .13	.12½– .13	.12½– .13
Lead arsenate, powd., bag, lb.	.11½– .12	.11½– .12	.11 – .12
Lime, chem., bulk, ton	8.50 –	8.50 –	8.50 –
Litharge, powd., csk., lb.	.08½–	.08½–	.08½–
Lithopone, bags, lb	.04½– .04¾	.04½– .04¾	.04½– .04¾
Magnesium carb., tech., bags, lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Methanol, 95%, tanks, gal.	.58 –	.58 –	.60 –
97%, tanks, gal.	.58 –	.58 –	.60 –
Synthetic, tanks, gal.	.28 –	.28 –	.28 –
Nickel salt, double, bbl., lb.	.13½– .13¾	.13½– .13¾	.13½– .13¾
Orange mineral, csk., lb.	.12½–	.12½–	.12½–
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb.	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb.	.09½– .10	.09½– .10	.09½– .10
Carbonate, 80–85%,calc.csk.,lb.	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb.	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 60% bags, unit	.53½–	.53½–	.53½–
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.19½– .20	.19½– .20	.19½– .20
Prussiate, yellow, casks, lb.	.17 – .18	.17 – .18	.17 – .18
Sal ammoniac, white, casks, lb.	.0515– .06	.0515– .06	.0515– .06
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –	17.00 –	17.00 –
Soda ash, light, 58%, bags, contract, cwt.	1.05 –	1.05 –	1.05 –
Dense, bags, cwt.	1.10 –	1.10 –	1.10 –
Soda, caustic, 76%, solid, drums, cwt.	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, del., bbl., lb.	.05 – .06	.05 – .06	.05 – .06
Bicarbonate, bbl., cwt.	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb.	.07½– .08	.07½– .08	.07½– .08
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	16.00 –17.00
Bisulphite, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Cyanide, cases, dom., lb.	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.08 – .09	.08 – .09	.08 – .09
Hyposulphite, bbl., cwt.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.50 – 2.65	2.50 – 2.65	2.50 – 2.65
Nitrate, bulk, cwt.	1.35 –	1.35 –	1.35 –
Nitrite, casks, lb.	.06½– .07	.06½– .07	.06½– .07
Phosphate, tribasic, bags, lb.	2.70 –	2.70 –	2.70 –
Prussiate, yel. drums, lb.	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.), wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb.	.03 – .03½	.03 – .03½	.03 – .03½
Sulphite, crys., bbl., lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Sulphur, crude at mine, long ton.	16.00 –	16.00 –	16.00 –
Chloride, dr., lb.	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb.	.07 – .08	.07 – .08	.07 – .08
Flour, bag, cwt.	1.90 – 2.40	1.90 – 2.40	1.90 – 2.40
Tin Oxide, bbl., lb.	.55 –	.55 –	.55 –
Crystals, bbl., lb.	.39½–	.39½–	.39½–
Zinc, chloride, gran., bbl., lb.	.05½– .06	.05½– .06	.05 – .06
Carbonate, bbl., lb.	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb.	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb.	.1035–	.1035–	.10½–
Oxide, lead free, bag, lb.	.07½–	.07½–	.07½–
5% leaded, bags, lb.	.07½–	.07½–	.07½–
Sulphate, bbl., cwt.	3.85 – 4.00	3.85 – 4.00	3.40 – 3.50

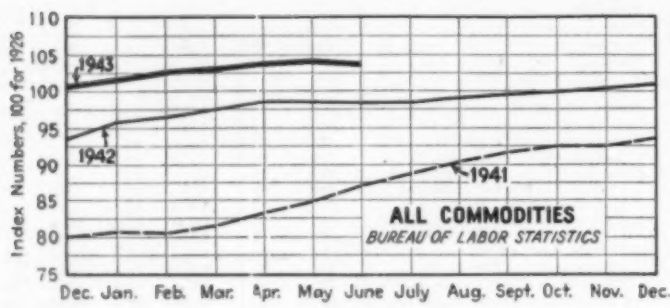
OILS AND FATS

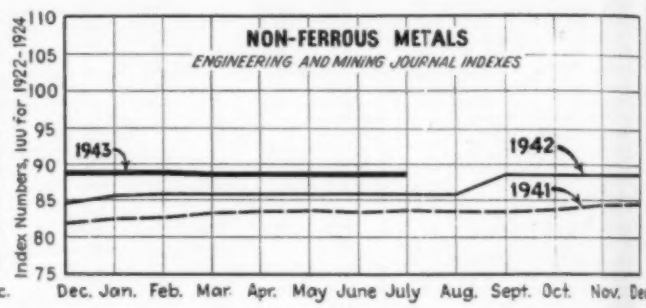
	Current Price	Last Month	Last Year
Castor oil, No. 3 bbl., lb.	$0.13½–$0.14½	$0.13½–$0.14½	$0.13½–$0.14½
Chinawood oil, bbl., lb.	.38 –	.38 –	.38 –
Coconut oil, Ceylon, tank, N. Y., lb.	nom	nom	nom
Corn oil crude, tanks (f.o.b. mill), lb.	.12½–	.12½–	.12½–
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12½–	.12½–	.12½–
Linseed oil, raw car lots, bbl., lb.	.153–	.153–	.139–
Palm, casks, lb.	.09 –	.09 –	.09 –
Peanut oil, crude, tanks (mill), lb.	.13 –	.13 –	.13 –
Rapeseed oil, refined, bbl., lb.	nom	nom	nom
Soya bean, tank, lb.	.11½–	.11½–	.11½–
Sulphur (olive foots), bbl., lb.	nom	nom	.19½–
Cod, Newfoundland, bbl., gal.	nom	nom	nom
Menhaden, light pressed, dr., lb.	.1305–	.1305–	.13 –
Crude, tanks (f.o.b. factory) lb.	.089–	.089–	.088–
Grease, yellow, loose, lb.	.08½–	.08½–	.08½–
Oleo stearine, lb.	.09½–	.09½–	.09½–
Oleo oil, No. 1	.11½–	.11½–	.11½–
Red oil, distilled, dp.p. bbl., lb.	.11½–	.11½–	.12 –
Tallow extra, loose, lb.	.08½–	.08½–	.08½–

Chem. & Met.'s Weighted Price Indexes








NON-FERROUS METALS
ENGINEERING AND MINING JOURNAL INDEXES
Index Numbers, 100 for 1922-1924
1943
1942
1941
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52- $0.55	$0.52- $0.55	$0.52 -$0.55
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.15 - .16	.15 - .16	.15 - .16
Aniline, salts, bbl., lb.	.22 - .24	.22 - .24	.22 - .24
Benzaldehyde, U.S.P., dr., lb.	.85 - .95	.85 - .95	.85 - .95
Benzidine base, bbl., lb.	.70 - .75	.70 - .75	.70 - .75
Benzoic acid, U.S.P., kgs., lb.	.54 - .56	.54 - .56	.54 - .56
Benzyl chloride, tech., dr., lb	.23 - .25	.23 - .25	.23 - .25
Benzol, 90%, tanks, works, gal.	.15 -.....	.15 -.....	.14 -.....
Beta-naphthol, tech., drums, lb.	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb.	.11 -.....	.11 - .11	.10½- .11
Cresylic acid, dr., wks., gal.	.81 - .83	.81 - .83	.81 - .83
Diethylaniline, dr., lb.	.40 - .45	.40 - .45	.40 - .45
Dinitrophenol, bbl., lb.	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluol, bbl., lb.	.18 - .19	.18 - .19	.18 - .19
Dip oil, 15%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, dr. f.o.b. wks., lb.	.60 -.....	.60 -.....	.70 -.....
H-acid, bbl., lb.	.45 - .50	.45 - .50	.45 - .50
Naphthalene, flake, bbl., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Nitrobenzene, dr., lb.	.08 - .09	.08 - .09	.08 - .09
Para-nitraniline, bbl., lb.	.47 - .49	.47 - .49	.47 - .49
Phenol, U.S.P., drums, lb.	.10½- .11	.10½- .11	.13 -.....
Picric acid, bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Pyridine, dr., gal.	1.70 - 1.80	1.70 - 1.80	1.70 - 1.80
Resorcinol, tech., kegs, lb.	.75 - .80	.75 - .80	.75 - .80
Salicylic acid, tech., bbl., lb.	.33 - .40	.33 - .40	.33 - .40
Solvent naphtha, w.w., tanks, gal.	.27 -.....	.27 -.....	.27 -.....
Tolidine, bbl., lb.	.86 - .88	.86 - .88	.86 - .88
Toluol, drums, works, gal.	.33 -.....	.33 -.....	.32 -.....
Xylol, com., tanks, gal.	.26 -.....	.26 -.....	.26 -.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.21 - .23½	.21 - .23½	.15- .17
China clay, dom., f.o.b. mine, ton.	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0335- .30	.0335- .30	.0335- .30
Prussian blue, bbl., lb.	.36 - .37	.36 - .37	.36 - .37
Ultramarine blue, bbl., lb.	.11 - .26	.11 - .26	.11 - .26
Chrome green, bbl., lb.	.21½- .30	.21½- .30	.21½- .30
Carmine, red, tins, lb.	4.60 - 4.75	4.60 - 4.75	4.60 - 4.75
Para toner, lb.	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb.	3.05 - 3.10	3.05 - 3.10	3.05 - 3.10
Chrome yellow, C.P., bbl., lb.	.14½- .15½	.14½- .15½	.14½- .15½
Feldspar, No. 1 f.o.b.N.C.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 - .10	.08 - .10	.08 - .10
Gum copal Congo, bags, lb.	.09 - .30	.09 - .30	.09 - .30
Manila, bags, lb.	.09 - .15	.09 - .14	.09 - .15
Demar, Batavia, cases, lb.	.10 - .22	.10 - .20	.10 - .22
Kauri, cases, lb.	.18 - .60	.17 - .60	.18 - .60
Kieselguhr (f.o.b. mines), ton.	7.00 -40.00	7.00 -40.00	7.00 -40.00
Magnesite, calc, ton	64.00 -.....	64.00 -.....	64.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 = .07
Imported, casks, lb.	nom	nom	nom .....
Rosin, H., 100 lb.	4.60 -.....	4.20-.....	3 41-.....
Turpentine, gal.	.74 -.....	.73½-.....	.61 -.....
Shellac, orange, fine, bags, lb.	.39 -.....	.39 -.....	.39 -.....
Bleached, bonedry, bags, lb.	.39 -.....	.39 -.....	.39 -.....
T. N. bags, lb.	.31 -.....	.31 -.....	.31 -.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
200 mesh (f.o.b. Ga.), ton.	6.00 - 8.00	6.00 - 8.00	6.00 - 8.00

Industrial Notes

ATLANTIC RESEARCH ASSOCIATES, INC., Newtonville, Mass., has passed from the control of National Dairy Products Corp. to F. C. Atwood who has resigned from the Aralac Corp.

BABBIT INDUSTRIAL SPECIALTIES CO., New York, has taken over the manufacture and sale of the sealing compounds formerly made by Namco, Inc., Nutley, N. J.

WHITING CORP., Harvey, Ill., through its Swenson division has secured manufacturing and sales rights to the Douthitt Gray-Jensen spray process drying systems formerly sold by the Douthitt Corp.

BOSTON WOVEN HOSE & RUBBER CO., Boston, has appointed W. F. Dashiell southern district sales manager with headquarters at Richmond.

COCHRANE CORP., Philadelphia, has appointed Roy L. Stone as its flow meter representative with offices in the Commerce Bldg., Rochester and, under V. J. Williams, at 295 Hartford Ave., Buffalo.

BARBER-COLMAN CO., Rockford, Ill., is now represented in Colorado, Wyoming, and part of Nebraska by Edwin C. Anderson, 1863 Wazee St., Denver.

PITTSBURGH EQUITABLE METER CO., Pittsburgh, has made Donald D. Foster acting head of the sales divisions of the parent company and of its subsidiary, the Merco Nordstrom Valve Co.

THE NICHOLSON CO., INC., 10 Rockefeller Plaza, New York, has been purchased by Wininger & Selby, Inc.

THE B. F. GOODRICH CO., Akron, has placed R. G. Cox in charge of molded goods sales. He succeeds E. R. Miller, recently retired.

GLOBE STEEL TUBES CO., Milwaukee, has moved C. A. Schroeder from Milwaukee to Cleveland where he will act as manager. E. Gammeter formerly at Chicago has been appointed chief metallurgist at Milwaukee.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has appointed Marcello A. King executive engineer of its Moore steam turbine division at Wellsville, N. Y.

THE BRISTOL CO., Waterbury, Conn., has named E. Nuber manager of the Pacific Coast branch offices and factory. He will make his headquarters at 40 Berry St., San Francisco.

ALLEGHENY LUDLUM STEEL CORP., Pittsburgh, has appointed Victor H. Mantz assistant to E. J. Hanley, secretary and treasurer. Mr. Mantz will be located at the Brackenridge, Pa., offices.

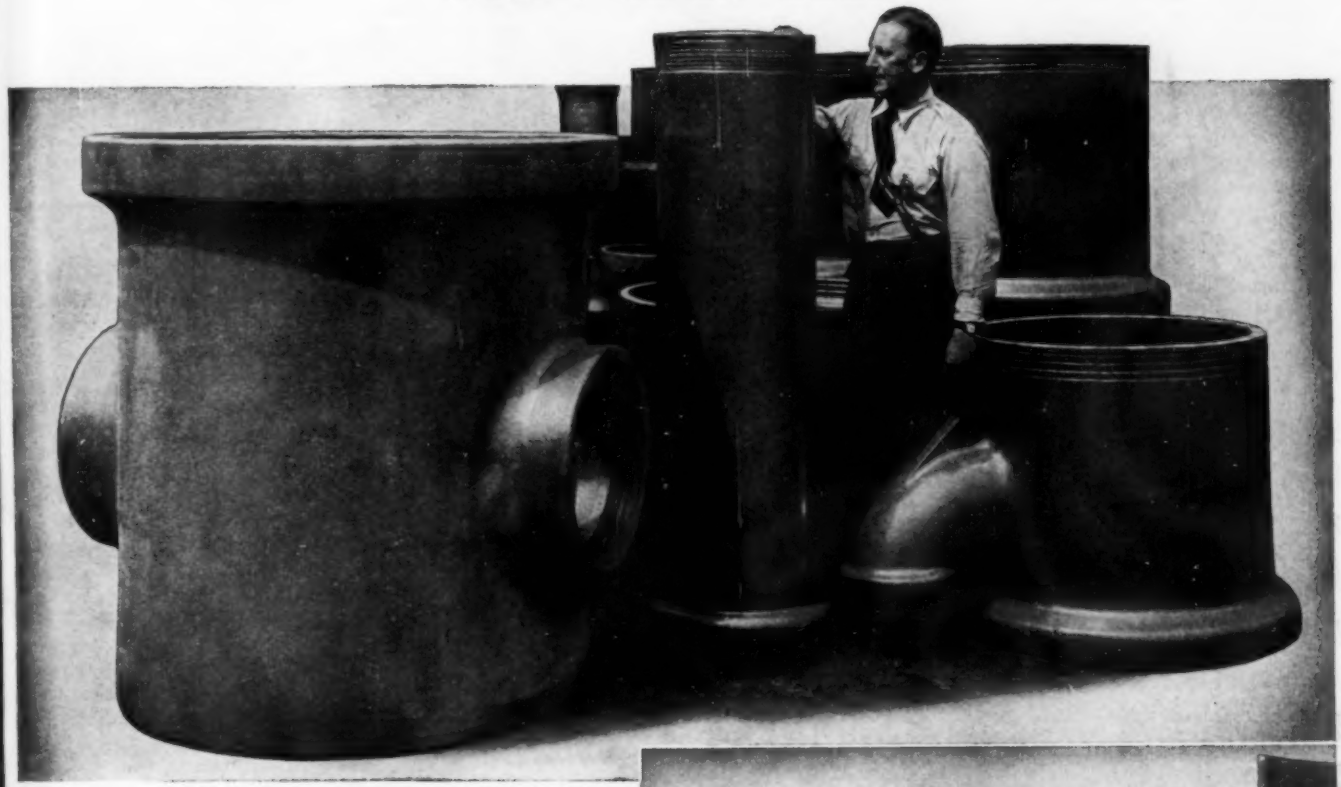
THE COOPER-BESSEMER CORP., Mount Vernon, Ohio, has placed Dave M. Whyte in charge of casting sales of the corporation's two foundries.

KNIGHT MAKES

Standard or Special Design

ACID-PROOF PIPE

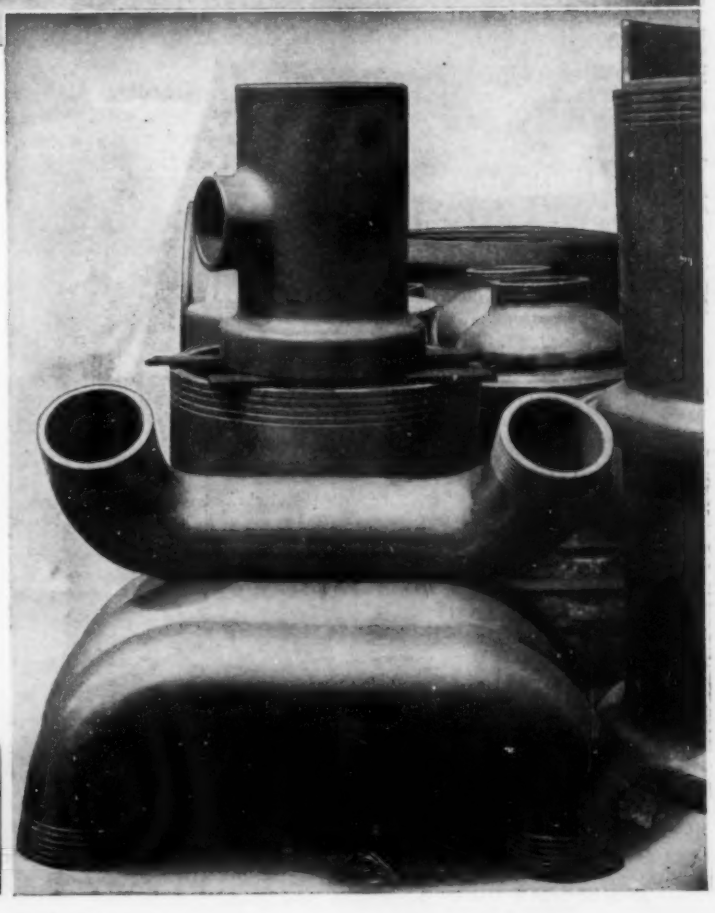
FROM 1" TO 60" BORE



Illustrated here are a few of many types of acid-proof pipe regularly being made by Maurice Knight. Bore sizes range from one to sixty inches. Knight also furnishes standard fittings such as elbows, T's, Y's, sanitary T's, traps, etc.; also special fittings to meet unusual installation conditions.

Knight supplies pipe with bell and spigot and flange type connections; also plain end pipe with metal flanges.

Knight-Ware acid-proof pipe is made of selected clays. Its entire body is acid-proof, not just the glaze alone. Because it is acid- and corrosion-proof, it is the ideal equipment for the processing of chemicals.



MAURICE A. KNIGHT, 108 Kelly Ave., Akron 9, Ohio

KNIGHT-WARE CHEMICAL EQUIPMENT

NEW CONSTRUCTION

	Current Projects		Cumulative 1943	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$40,000	$40,000	$335,000	$430,000
Middle Atlantic	170,000	40,000	14,369,000	4,944,000
South	40,000	.....	7,343,000	6,940,000
Middle West	.....	.....	8,960,000	9,685,000
West of Mississippi	1,540,000	754,000	13,890,000	11,635,000
Far West	13,560,000	.....	15,525,000	57,126,000
Canada	494,000	393,000	11,086,000	1,520,000
Total	$15,844,000	$1,227,000	$71,508,000	$92,280,000

PROPOSED WORK

Calif., Richmond—Phillippine Refining Co., Point San Pablo, plans to rebuild its warehouse. Estimated cost $60,000.

Calif., Richmond—Defense Plant Corp., 811 Vermont Ave., N. W., Washington 25, D. C., plans to construct an oil refinery to be operated by the Standard Oil Co., 225 Bush St., San Francisco. Estimated cost $13,500,000.

Kan., McPherson—National Cooperative Refinery Assn., McPherson, plans to improve and recondition a refinery plant which it has recently purchased here.

Ky., Ashland—Ashland Oil & Refining Co., Ashland, plans to construct additional facilities at its plant here.

Mass., Malden—Converse Rubber Co., 392 Pearl St., will soon award the contract for the construction of a 1 story, 80x85 ft. addition to its plant. A. Rosenstein, 120 Milk St., Boston, Archt.

N. J., Garfield—Heyden Chemical Co., 50 Union Sq., New York, N. Y., and 290 River Rd., Garfield, is having plans prepared for the construction of a 3 story brick factory building.

N. J., Rahway—The Merck Co., 126 East Lincoln Ave., is having plans prepared by The Ballinger Co., 105 East 12th St., Philadelphia, Pa., for general alterations to its manufacturing plant.

Pennsylvania—B. F. Goodrich Co., 500 South Main St., Akron, O., is having plans prepared by Albert Kahn Associated Engineers & Architects, 345 New Center Bldg., Detroit, Mich., for additions to its factory here.

Pa., Meadville—American Viscose Corp., H. Miller, Engr., Meadville, plans to construct a 90 ft. trickling basin with equipment. Havens & Emerson, Leader Bldg., Cleveland, O., Engrs. Estimated cost $50,000.

Texas—Goodyear Rubber Co. and General Tire & Rubber Co., 1144 East Market St., Akron, O., plans to enlarge its plant here. W. D. LaRue, c/o Goodyear Tire & Rubber Co., Baytown, Engr. Project will be financed by Defense Plant Corp. Estimated cost $1,250,000.

Tex., Palestine—Knox Glass Bottle Co. will construct an additional unit at its plant here. Estimated cost $250,000.

Ont., Guelph—Guelph Chemical Co., Ltd., c/o N. Phillips, Atty.-at-Law, 171 Yonge St., Toronto, plans to construct a plant for the manufacture of chemicals, dyestuffs, oils, etc. Estimated cost $40,000.

Ont., Toronto—Bakelite Corp. of Canada, Ltd., 163 Dufferin St., plans to construct a 2 story, 40x60 ft. plant addition. Estimated cost $41,000.

Ont., Toronto—Castle Chemical Works, Ltd., M. L. Gordon, Counsellor, Northern Ontario Bldg., plans to construct a plant. Estimated cost $50,000.

Ont., Toronto—G. Nottingham, c/o Rogers Works, Ltd., 361 Oakwood Ave., plans to construct a paint and varnish plant. Estimated cost $50,000.

Que., Drummondville—Canadian Celanese, Ltd., R. H. Sperling, Plant Mgr., plans to alter and install new equipment in its plant here. Estimated cost $313,000.

CONTRACTS AWARDED

Arkansas—Defense Plant Corp., Washington, D. C., has awarded the contract for the construction of a zinc recovery plant to be operated by the Athletic Mining & Smelting Co., R. F. Orr, Pres., Fort Smith, to Murch-Jarvis Co., Inc., 705 Olive St., St. Louis, Mo. Estimated cost $550,000.

Mass., Springfield—Shawinigan Resins Corp., 644 Main St., Indian Orchard, Mass., has awarded the contract for the construction of a 1 story, 62x85 ft. laboratory to Adams & Ruxton Construction Co., 1387 Main St., Springfield.

Mo., St. Louis—Blanton Co., 3400 North Wharf St., has awarded the contract for superstructure of 1 story, 77x103 ft. soybean plant to Alport Construction Co., 7th and Locust Sts., Zone 1.

Pa., Creighton—Pittsburgh Plate Glass Co., M. E. Carlisle, Purch. Agt., Grant Bldg., Pittsburgh, has awarded the contract for the construction of a 1 story, 100x2500 ft. assembly Bldg., to Groomes Construction Co., Box 133, Springdale. Estimated cost $40,000.

S. D., Sioux Falls—Sioux Falls Rendering Co. has awarded the contract for the construction of a soybean processing plant to Newell Construction Co., 525 H St., Cedar Rapids, Ia. Estimated cost including equipment will exceed $40,000.

Tex., Fort Worth—Armour & Co., Fort Worth, has awarded the contract for a 77x156 ft. serum albumin plant to Thos. S. Byrne, Inc., Fort Worth National Bank Bldg., at $123,500.

Alta., Exshaw—Canada Cement Co., Ltd., Canada Cement Bldg., Montreal, Que., has awarded the contract for the construction of a 50 ft. diam. silo here, to Carter-Halls-Aldinger, Ltd., Royal Bank Bldg., Winnipeg, Man. Estimated cost $65,000.

Que., Arvida—Abrasive Co. of Canada, Ltd., 14 Drake St., has awarded the contract for two additions to its plant to Foundation Co. of Canada, Ltd., 1538 West Sherbrooke St., Montreal. Estimated cost $50,000.

Que., Montreal—McKenna & Harrison, Ltd., 485 McGill St., Montreal, pharmaceutical chemists, have awarded the contract for research laboratory buildings to Foundation Co. of Canada, Ltd., 1538 Sherbrooke St., W., Montreal. Estimated cost $160,000.

Que., Thetford Mines—Asbestos Corp., Ltd., 14 Notre Dame St., has awarded the contract for an addition to its plant to L. Poudrier, 21 Cyr St. Estimated cost $60,000.

Que., Valleyfield — Canadian Bronze Powder Works, Ltd., 9-13 East Park, has awarded the contract for rebuilding three of its plant units, to Cooke & Leitch, 1440 St. Catherine St., W., Montreal, at $57,680.